UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

Subject: Distribution of Newmark OU Final Documents

Dear Colleague (see Addressees list):

Enclosed you will find a CD with an electronic copy of the following reports, in pdf format.

1. Cost and Performance Report for Newmark Operable Unit Remedial Action, Newmark Groundwater Contamination Superfund Site

2. Operation, Maintenance, and Performance Manual: Newmark Treatment System, Newmark Groundwater Contamination Superfund Site

3. Remedial Action Report for Newmark OU Remedial Action, Newmark Groundwater Contamination Superfund Site

Due to the high cost of printing these reports, hard copies distribution are very limited. If you would like to have one , please let me know.

Thank you for your interest. I look forward to our continued collaboration in the treatment of the Newmark groundwater contamination.

Sincerely,

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NEWMARK GROUNDWATER CONTAMINATION SUPERFUND SITE
NEWMARK OPERABLE UNIT REMEDIAL ACTION

OPERATION, MAINTENANCE, AND PERFORMANCE MANUAL
NEWMARK TREATMENT SYSTEM

FINAL

Prepared for:

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DISCLAIMER

This manual has been prepared for the United States Environmental Protection Agency (EPA) by URS Group, Inc. (URS). This document presents the procedures associated with operating the facilities and equipment at the Newmark Operable Unit (OU). The project is at the Newmark Groundwater Contamination Superfund Site (Site), Newmark OU, in San Bernardino, California.

This manual has been prepared by URS under the review of registered professionals. The data and conclusions in this report are based on information provided to URS by others and on information from URS contract files. The summaries, interpretations, and conclusions presented in this report were governed by URS' experience and professional judgment.

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TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

Page

LIST OF ATTACHMENTS

LIST OF APPENDICES

LIST OF FIGURES
(Provided at the end of this manual)

LIST OF TABLES

VOLUME II: Manufacturers' Instruction Manuals (provided under separate cover)

ACRONYMS AND ABBREVIATIONS

Al	aluminum
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
BART	Biological Activity Reaction Test
BFV	butterfly valve
Ca	calcium
Cl	chlorine
COC	constituent of concern
DHS	California Department of Health Services
DI	ductile iron
DN	denitrifying bacteria
Eh	electrical conductivity
EW	extraction well
Fe	iron
FIPT	female iron pipe thread
FL	flange (joint)
GAC	granular activated carbon
GFCI	ground-fault circuit interrupter
gpm	gallons per minute
GV	gate valve
I&C	instrumentation and controls
ID	identification
IRB	iron-related bacteria
mA	milliampere
MCL	maximum contaminant level
Mg	magnesium
mg/L	milligrams per liter
mgd	million gallons per day
MIPT	male iron pipe thread
MJ	mechanical joint
Mn	manganese
MW	monitoring well
Na	sodium
OMP	operation, maintenance, and performance
OU	Operable Unit
O&M	operations and maintenance
PCE	tetrachloroethene
PLC	programmable logic controller

ACRONYMS AND ABBREVIATIONS (Continued)

ppm	parts per million
PRV	pressure-reducing valve
psi	pounds per square inch
psig	pounds per square inch gauge
PSV	pressure-sustaining valve
PVC	polyvinyl chloride
ROD	Record of Decision
RPM	rotations per minute
S	sulfur
SBMWD	San Bernardino Municipal Water Department
SCADA	supervisory control and data acquisition
SLYM	slime-forming bacteria
SRB	sulfate-reducing bacteria
SVOC	semivolatile organic compound
TCE	trichloroethene
TDS	total dissolved solids
URSG	URS Greiner Woodward-Clyde Federal Services
U.S. EPA	United States Environmental Protection Agency
V	volt
VFD	variable frequency drive
VOC	volatile organic compound

1.0 INTRODUCTION

This manual presents operation, maintenance, and performance (OMP) information pertaining to extraction wells (EWs), monitoring wells (MWs), conveyance pipelines, and treatment plants associated with three groundwater pump-and-treat plants in the Newmark Operable Unit (OU) at the Newmark Groundwater Contamination Superfund Site in San Bernardino, California. The three plants are the Newmark Plant, the Waterman Plant, and the 17th Street Plant.

This section describes the history of the Superfund site and presents the purpose and scope of this OMP manual.

1.1 SITE HISTORY

The City of San Bernardino uses groundwater as its sole source of drinking water. Volatile organic compounds (VOCs), primarily tetrachloroethene (PCE) and trichloroethene (TCE) and their degradation products, were discovered in certain drinking water wells in the early 1980s. This area of contamination, which was designated the Newmark OU by the United States Environmental Protection Agency (U.S. EPA), is shown on Figure 1-1 (all figures are presented at the end of this document.) The source of the Newmark OU contamination is unknown, but it is suspected to be a military establishment.

Studies have indicated that if the City were to drill new drinking water wells outside of the groundwater contaminant plume, the pumping would cause the plume to expand. To prevent this, the U.S. EPA initiated an interim remedial action in 1993 that involved constructing barrier extraction wells, extracting water from those wells to prevent the further migration of the Newmark OU Plume, treating the extracted groundwater to acceptable standards, and then discharging that water into the San Bernardino Municipal Water Department (SBMWD) drinking water reservoirs.

A Record of Decision (ROD) dated August 4, 1993 (U.S. EPA, 1993), outlines the requirement for two groundwater extraction and treatment systems, one system in the northern area of the Newmark OU, designated as the North Plant (consisting of the Newmark Plant) (see Figure 1-2) and the second system in the southern area, designated as the South Plant (consisting of the Waterman and 17th Street Plants) (see Figure 1-3). These groundwater treatment plants, along with their associated 8 extraction wells, pipeline conveyance systems, and 14 monitoring wells, are included in the remedy.

1.2 PURPOSE AND SCOPE OF THE OMP MANUAL

This OMP manual is a guide to operating and maintaining the Newmark OU remedy, which includes the extraction wells, monitoring wells, conveyance pipelines and Newmark, Waterman, and 17th Street Plants. This manual presents the performance guidelines for the systems that should be followed to ensure efficient operation and the desired outcome and is intended to be used with the following reports/documents.

- *100% Design Report, Newmark OU Remedial Design, Newmark Groundwater Contamination Superfund Site, North Plant* (URSG, 1997b).
- *Construction/As-Built Drawings, Newmark OU Remedial Design, Newmark Groundwater Contamination Superfund Site, North and South Plants* (URSG, 1997c, URSG, 1999).
- *SBMWD Waterman Treatment Plant Operations Plan* (SBMWD, 1998).
- *SBMWD North Treatment Plant Operations Plan* (SBMWD, 2003a).
- *SBMWD 17th Street Treatment Plant Operations Plan* (SBMWD, 2003b).
- *SBMWD Operation and Maintenance Plan* (SBMWD, publication pending).

The first three reports/documents were prepared by URSG as part of the interim remedial efforts at the site. SBMWD developed the operations plans for the three plants to obtain approval from the California

Department of Health Services (DHS) for the operation of the treatment plants. The last report will be developed by SBMWD.

This OMP manual consists of two volumes.

Volume I:
- Section 1.0 - Introduction
- Section 2.0 - Extraction Wells
- Section 3.0 - Pipeline Conveyance System
- Section 4.0 - Treatment Plant System
- Section 5.0 - Monitoring Wells
- Section 6.0 - Supervisory Control and Data Acquisition (SCADA)
- Section 7.0 - References
- Appendix A - GAC Treatment Plant Parts List
- Appendix B - HP-1020S-SYS Pressure Drop
- Appendix C - PM Schedules and Troubleshooting
- Appendix D - Photographs
- Attachment I - SBMWD Sampling Procedure for Carbon Changeout, October 11, 2000

Volume II:
- Operating instructions provided by equipment manufacturers.

2.0 EXTRACTION WELLS

This section describes the OMP of the extraction wells and their components. Figures 2-1 and 2-2 present the mechanical and electrical details, respectively, of the extraction wells.

2.1 DESCRIPTION OF THE EXTRACTION WELLS

2.1.1 Treatment Plant Wells

The Newmark OU extraction wells are grouped according to the actual location of the groundwater treatment. Three extraction wells (Newmark-3, EW-6, and EW-7) feed into the North Plant. Four extraction wells (EW-1, EW-2, EW-4, and EW-5) feed into the Waterman Plant; only one extraction well, EW-3, feeds into the 17th Street Plant.

2.1.2 Construction of the Extraction Wells

The North Plant wells consist of an older well, Newmark-3, which was constructed in 1954, and two new EPA wells, EW-6 and EW-7, both of which were constructed in 1996. Construction of the South Plant wells occurred in 1996. Each well is capable of producing approximately 2,000 gallons per minute (gpm). Actual pumping rates were determined using plume geohydraulics. Table 2-1 describes the locations, depths, screened intervals, and diameters of each extraction well associated with the Newmark OU. Figure 2-1 provides the well schematics for each extraction well.

TABLE 2-1

Well Locations, Depths, Screened Intervals, and Diameters

Extraction Well Number	Address	Depth (feet)	Screened Interval(s) (feet)	Diameter of Well (inches)
North Plant				
Newmark -3	48th Street, east of Little Mountain	495	232-270 283-305 331-462	16
EW-6	Kendall Drive and Western Avenue	340	115-315	16
EW-7	1295 W. 48th Street	480	200-270	16
South Plants				
EW-1	1094 N. E Street	1,200	600-1,190	16
EW-2	1108 N. Arrowhead Avenue	1,080	500-1,070	16
EW-3	226 W. 11th Street	810	240-280 320-400 500-800	16
EW-4	107 W. 11th Street	1,200	490-1,180	16
EW-5	217 E. 11th Street	1,150	400-1,130	16

EW = extraction well

2.1.3 Goal of the Extraction Wells

2.1.3.1 North Plant Wells

The North Plant wells were positioned to monitor and intercept groundwater near the upgradient edge of the Newmark OU Plume. The locations and pump rates of these wells were designed to decrease concentrations of contaminants closer to the suspected source, thus reducing the overall mass of contaminants in the plume. The concentrations in each well should decrease over time as contaminant mass is removed at the treatment plant.

2.1.3.2 South Plant Wells

The South Plant wells were placed to intercept contaminated groundwater at the leading edge of the Newmark OU Plume. The pump rates associated with these wells are designed to retard the further migration of the plume. Therefore, as long as the downgradient monitoring wells do not detect contaminants associated with the Newmark OU, the number of wells, their placement, and their pumping rates are sufficient to ensure this goal is met.

2.2 EXTRACTION WELL COMPONENTS

The extraction well components are discussed hereafter.

2.2.1 Connections and Valving Between Pipelines and Wells

An extraction well is connected to the conveyance pipeline by means of a welded steel connector pipe. An isolation valve and air-release valve are near the wellhead assembly. The connector pipe exits the well above ground and then extends below grade to connect with the pipeline conveyance system (see Appendix D, Photo 1).

2.2.2 Pumps

The pumps for EW-6, EW-7, and Newmark-3 are water-lubricated vertical turbine pumps. The pumps for EW-1 through EW-5 are variable frequency drive (VFD), submersible pumps that are set at optimal pumping rates based on plume modeling. The pumps extract groundwater and transport it into the pipeline conveyance system. Table 2-2 shows the rotations per minute (RPM), discharge head, horsepower, and flow rate of the pumps (see Appendix D, Photos 2 and 3).

2.2.3 Motors

The North Plant well pump motors are totally enclosed, fan-cooled, vertical-shaft, deep-well turbine, three-phase, 460-volt (V) rated motors. The motors are mounted to concrete and steel mounting assemblies over the wells.

The South Plant well pump motors are submersible, three-phase, 460-V, variable-speed rated motors. They are run as full voltage or constant speed or are driven with VFD controllers.

2.2.4 Pressure Transducer

The pressure transducers are solid state, two-wire transducers producing a milliampere (mA) signal directly proportional to the water depth above the transducer. The pressure transducers are installed near the bottom of the wells to provide well depth information to the control and monitoring system. The mA signal has been routed from the existing control panels to new supervisory control and data acquisition (SCADA) panels for remote indication. The signal could also be used by the South Plant pump motor VFD control circuits to control well levels.

TABLE 2-2

Well Pump Specifications

Extraction Well Number	RPM	Discharge Head	Horsepower	Flow Rate (gpm)
North Plant				
Newmark-3	1,800	275 feet @ 1,000 gpm	250	1,600
EW-6	1,800	245 feet @ 1,000 gpm	100	1,000
EW-7	1,800	235 feet @ 1,300 gpm	100	1,300
South Plant				
EW-1	1,800 (VFD)	449 feet @ 2,000 gpm	350	2,000
EW-2	1,800 (VFD)	449 feet @ 2,000 gpm	350	2,000
EW-3	1,800 (VFD)	290 feet @ 2,200 gpm	250	2,200
EW-4	1,800 (VFD)	449 feet @ 2,000 gpm	350	2,000
EW-5	1,800 (VFD)	449 feet @ 2,000 gpm	350	2,000

EW extraction well
gpm gallons per minute
RPM rotations per minute
VFD variable frequency drive

2.2.5 Valves

Manually operated butterfly valves are installed near the wellheads so that each individual well can be isolated from the pipeline conveyance system.

2.2.6 Casing and Well Screen

The well casings are made of carbon steel. The well screens are constructed of slotted stainless steel.

2.2.7 Transformer

The power transformer converts the incoming high voltage to three-phase 480/277-V power and single-phase 120/208-V power for use by the process electrical equipment and control systems. The power transformer is self-contained and protected by circuit breakers on the high-voltage and low-voltage systems connected to it. The power from the transformer low-voltage compartment (secondary power) is distributed to individual electrical loads through a power distribution board (see Appendix D, Photo 4).

2.2.8 Electrical Control System

The electrical control system starts and stops pumps, monitors the process values, and reports system information to the City’s centralized SCADA system. The electrical control system interfaces with all electrical equipment to control system operations. The various process signals (water flow rate, extraction well level) are brought into the control panels, isolated through conditioning devices, and then brought into programmable logic controllers (PLCs) for verification of signal value, alarm functions, and control logic.

2.2.9 Flow Meter

A water flow meter is provided at the discharge of each extraction well. The in-line propeller-type flow meter generates an mA signal proportional to the instantaneous flow rate through the meter. The mA signal is routed from the existing control panel to the new SCADA panel, enabling remote monitoring of the well flow rate. The well flow rate signal also could be used by the pump motor VFD control circuit to control well flow rate. The well flow meter generates a pulse output signal that is routed to the well control panel and is then monitored by the SCADA system to determine the total volume flowing through the meter (see Appendix D, Photo 5).

2.2.10 Check Valve

The in-line check valve is a one-way-flow directional valve that prevents water from running back into the extraction well when the well is turned off. Conveyance system back pressure closes the check valve when the well pump is not discharging associated water. The check valve prevents conveyance system water (e.g., from other extraction wells) from entering the associated extraction well (see Appendix D, Photo 3).

2.2.11 Vacuum-Release Valve

At the top of each wellhead, before the check valve, is a vacuum-release valve. When the well pump is shut down, the column of water in the pipe above the well pump falls back down the well, creating a vacuum in the pump's discharge piping. The vacuum-release valve allows air to enter the pipeline, thereby breaking the vacuum and preventing pipe collapse (see Appendix D, Photo 3).

2.2.12 Air/Vacuum-Release Valve

The air/vacuum-release valve allows accumulated air to escape from the pipe at the wellhead; in the case of rapid draining, it allows air to enter, preventing pipe collapse (see Appendix D, Photo 5).

2.2.13 Well Drain System

Various drains are set up to allow the wells to be pumped directly to the storm drain system, bypassing the treatment plant. Usually, bypassing is done when the well is being flushed, pump tested, or developed.

2.3 EXTRACTION WELL OPERATION

The following section describes the operating procedures for the extraction wells.

2.3.1 Initial Startup Procedures

1. Disinfect the wells as outlined in Section 10 of the *SBMWD Waterman Treatment Plant Operations Plan* (SBMWD, 1998) and prepare the pumps in the extraction wells for startup as outlined in the *SBMWD Operations and Maintenance Manual* (SBMWD O&M Manual) (SBMWD, In Preparation).

2. Flood the line shaft bearings. Partially open the butterfly valve (BFV) at the extraction well. After the rest of the system components are ready for startup, as detailed in Sections 3.0 and 4.0, activate the extraction well pumps.

3. Slowly open the BFV at the extraction well to reach the desired flow rate.

4. Monitor the system for any leaks, vibrations, or unusual noises. Identify and initiate corrective actions as necessary.

2.3.2 Shutdown Procedures

Under normal operating conditions, the well pumps shut down when the command is given from the remote operating center. Check valves installed in the pipeline at each wellhead minimize the backward flow of water down the well. To prevent the backward flow of water, close the BFV at each extraction well.

2.3.3 Normal Operating Procedures

It is normal operation for the extraction wells to run at design capacity (see Table 2-2). The wells are operated 24 hours per day every day, except during maintenance periods or equipment failures.

2.3.3.1 Operation at Reduced Capacity

The pumping rates will be set by SBMWD depending on the need for water and the minimum amount of water that can be extracted to achieve the ROD objective. The wells with VFD motors can be operated at a reduced capacity.

2.3.3.2 Disinfection

The extraction wells should be disinfected with chlorine solution after any downhole well maintenance activity or whenever coliform or other bacteriological activity is detected. Disinfection should be performed using chlorine in accordance with American Water Works Association (AWWA) standards.

2.3.4 Emergency Operating Procedures

In an emergency (power failure, equipment failure, or an act of nature), the well pumps will shut down on command from the remote operating center. Check valves installed in the pipeline at each wellhead will minimize the backward flow of water down the well. The BFV at the extraction well will have to be closed manually. When the wells are restarted, the BFVs must be reopened.

2.3.5 System Flows

Normal pumping and minimum/maximum rates for the system are presented so that operators can determine whether flows are outside of acceptable ranges. **Information not provided by SBMWD.**

2.3.6 Data Collection and SCADA Inputs

Various extraction well signals, status information, and controls are input to and taken from the existing control system. The existing control system has been modified to use many of these signals as inputs for the new centralized SCADA system. The SCADA system uses PLC input cards at the well control panels to send the extraction well information and controls to the SCADA main control center in the City offices.

Process analog input signals to the PLC include water flow rates and extraction well levels. The local PLC processes the analog signals and sends them via the PLC-SCADA communication cable to the SCADA system. The SCADA system monitors all PLC data and provides the information to the operators at the central SCADA monitoring area.

The typical SCADA analog input (continuous real-time process value) is taken from an analog signal (typically 4-20 mA) to a new control panel terminal block, then through a signal isolator. The signal isolator produces a “clean” signal to the PLC unit. The PLC processes the signal and verifies whether it is out of typical boundary values. When the PLC identifies a problem with the process, it generates an alarm signal that notifies the operator by illuminating a local alarm light at the well control panel (see Appendix D, Photos 6 and 7).

2.3.7 Troubleshooting

See the SBMWD O&M Manual (SBMWD, In Preparation).

2.4 EXTRACTION WELL MAINTENANCE

The following subsections describe the maintenance procedures for the extraction wells. Refer to Appendix C for preventive maintenance schedules and troubleshooting guidelines.

2.4.1 Site Maintenance

The extraction well sites will be maintained in the same way as they are at other SBMWD locations. At a minimum, the following procedures will be followed during each site inspection:

- Collection of trash;
- Weed control; and
- Cleaning and repainting of areas marked with graffiti.

2.4.2 Well Maintenance

The following extraction well operating parameters will be monitored daily:

- Water level;
- Water level drawdown;
- Water flow from well; and
- Electrical current draw.

The wells are sounded monthly, and the motor efficiency and pump RPMs are checked annually. Sampling and analyses for inorganics, nitrates, radiological constituents, constituents of concern (COCs), VOCs, and semivolatile organic compounds (SVOCs) will be conducted according to the schedules in the DHS permit.

2.4.3 Component Maintenance

The following subsections describe the maintenance of the extraction well pump, motor, valves, pressure transducer, and water flow meter. Extraction well maintenance records will be kept up to date and will include the following:

- Startup dates;
- Operating times;
- Flow rates;
- Run-time hours;
- Coliform test results;
- Shutdown dates; and
- General maintenance activities.

2.4.3.1 Pump

The pump will be removed whenever efficiency drops below acceptable levels or when there is a mechanical failure. During this servicing, the pump bowl assembly and other components will be checked for wear and replaced as needed.

2.4.3.2 Motor

The motor will be serviced every 10,000 hours. During service, the oil will be changed, and the moving parts will be lubricated. All components will be checked for wear and repaired or replaced, as needed.

2.4.3.3 Valves

The valves will be operated annually. If a valve fails to function properly, it will be repaired or replaced as needed.

2.4.3.4 Air-Release Valves

Air-release valves will be checked for correct operation once per week. If an air-release valve is not operating correctly, it will be repaired or replaced as needed.

2.4.3.5 Pressure Transducer (Calibration)

The pressure transducers will be calibrated every 6 months. A pressure transducer should be operating within +/- 5%. If the pressure transducer does not calibrate to specification, it will be repaired or replaced as needed.

2.4.3.6 Water Flow Meters

Water flow meters will be calibrated annually, and the results of the calibration test will be provided to the DHS. If a meter does not calibrate to specification, it will be repaired or replaced as needed.

2.5 EXTRACTION WELL REMEDY CONFORMANCE

2.5.1 North Plant Wells

Since the North Plant wells are situated in the source area, remedy conformance can be ascertained by measuring the statistically decreasing levels of contaminants in extraction wells over time.

2.5.2 South Plant Wells

The South Plant wells are positioned at the leading edge of the plume and should pump a sufficient volume of groundwater to prevent the plume from continuing to move downgradient. Remedy conformance can be ascertained by confirming that contaminant levels in downgradient monitoring wells are not increasing statistically.

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3.0 PIPELINE CONVEYANCE SYSTEM

This section describes the OMP of the pipeline conveyance system and its components. Figures 3-1 through 3-6 present the mechanical details of the pipeline conveyance system.

3.1 DESCRIPTION

The treatment plant conveyance systems, their construction, and their goals are described in this section.

3.1.1 Treatment Plant Pipeline Conveyance Systems

3.1.1.1 North Plant

The North Plant pipeline includes pipelines from extraction wells EW-6, EW-7, and Newmark-3. From EW-6, a 12-inch diameter ductile iron (DI) waterline directs water west-northwest to Western Avenue. At Western Avenue, the pipeline proceeds north under Western Avenue to EW-7. At EW-7, the pipelines from EW-6 and EW-7 are joined by a 12-inch diameter tee. From the tee, the pipeline proceeds north along the flood control channel through a 12-inch diameter by 16-inch diameter reducer. From the reducer, a 16-inch diameter line proceeds north to Newmark-3. The 12-inch diameter pipeline from Newmark-3 joins the 16-inch diameter main pipeline at a 16-inch diameter by 16-inch diameter by 12-inch diameter reducing tee. From the tee, the 16-inch diameter line proceeds north along the flood control channel to the North Plant. At the North Plant, the pipeline is connected via a 16-inch diameter by 20-inch diameter reducer and a 20-inch diameter by 24-inch diameter reducer to the 24-inch diameter DI waterline leading into the plant. For details see Figure 3-1.

3.1.1.2 South Plant

The South Plant pipeline conveyance system is connected to both the Waterman and the 17th Street Plants, as described hereafter. The connection points to these plants are described in Section 4.0.

Waterman Plant

The Waterman Plant has western and eastern supply branches. The western branch is for EW-1 and EW-2; the eastern branch is for EW-4 and EW-5.

Western Branch (EW-1 and EW-2) - From EW-1, a 16-inch diameter DI waterline directs water to the north along Stoddard Avenue to 11th Street, then east to the EW-2 connection. Connection at EW-2 is through a 12-inch diameter adapter to a 16-inch diameter BFV at a tee; from there, the water flows east through a 16-inch diameter pipeline toward EW-3. Alternatively, flows from EW-1 and EW-2 may be directed independently to a 12-inch diameter waste line via 12-inch diameter gate valves (GVs) leading to drains on Sierra Way.

The combined EW-1/EW-2 water then flows eastward through a 16-inch diameter DI waterline to Mountain View Avenue. For details see Figures 3-2 and 3-3.

Eastern Branch (EW-4 and EW-5) - From EW-5, a 12-inch diameter DI waterline extends north to a 90-degree elbow, then to the west along 11th Street. A blow-off valve is installed at the 90-degree elbow. At Sierra Way, the 12-inch diameter DI waterline is connected to a 12-inch diameter tee. At the tee, normal flow is west to the EW-4 connection. Alternatively, like EW-1 and EW-2 flows, the EW-5 flow may be directed independently to the 12-inch diameter waste line leading east to the Sierra Way drains via a 12-inch diameter GV. For details see Figures 3-2 and 3-3.

A 12-inch diameter DI waterline extends north from EW-4 to a 12-inch diameter tee. Normal flow through the tee is to the north via a 12-inch diameter GV to a 12-inch diameter tee; the flow is joined there with flow from EW-5. Normal flow from the tee is to the east via a 12-inch diameter by 16-inch diameter reducer to a 16-inch diameter DI waterline. Alternatively, flow from EW-4 may be directed to the south via a 12-inch diameter GV to a 12-inch diameter tee into the EW-1/EW-2 waste line leading east to the Sierra Way drains. For details see Figures 3-2 and 3-3.

At Mountain View Avenue, the EW-4/EW-5 flow combines with the EW-1/EW-2 flow at a 16-inch diameter by 24-inch diameter tee. From the tee, the combined EW-1/EW-2/EW-4/EW-5 flow is through a 24-inch diameter DI waterline to the north, along Mountain View Avenue to Marshall Boulevard. At Marshall Boulevard, a mechanical joint (MJ) 90-degree bend directs flow to the east to the Waterman Plant. For details see Figures 3-2 through 3-6.

At the Mountain View overcrossing, 380 feet of 20-inch diameter DI waterline extends through a 30-inch diameter casing installed in the overcrossing structure. This section of pipe may be isolated by closing valves 007-261 and 007-258 (see Figure 3-5).

17th Street Plant

The 17th Street Plant includes the pipeline from EW-3. Normal flow from EW-3 is through a 16-inch diameter DI waterline, through a 16-inch diameter BFV, and then east to Mountain View Avenue. Normal flow from EW-3 is then north on Mountain View Avenue to the 17th Street Plant. Alternatively, flow from EW-3 may be directed through a 16-inch diameter by 12-inch diameter reducing tee and a 12-inch diameter GV to the 12-inch diameter waste line leading to the Sierra Way drains, or through a 16-inch diameter BFV to the 16-inch diameter EW-1/EW-2 waterline. For details see Figures 3-2, 3-3, and 3-4.

3.1.2 Construction of Pipeline Conveyance Systems

Table 3-1 describes the pipeline materials for the North and South Plants. The pipeline conveyance system valves are presented in Table 3-2.

TABLE 3-1

Conveyance System Materials for the North and South Plants

Item	Description Size (inches)	Specification	Location
PVC Waste Line	12 PVC pipe and PVC fittings	C 900	11th Street and Sierra Way
Ductile Iron Pipe	8, 12, 16, 20, 24	Class 50, 51	Sitewide
Mechanical Joints	8, 12, 16, 20, 24	Megalug, Series 1100	Sitewide
Pipe Saddles	14	Ford Meter Box Co., Model 202BS	Sitewide
Ductile Iron Flanged Bends	8, 12, 24	Class 50, 51	Sitewide
Ductile Iron Flanged Tees	8, 12, 24	Class 50, 51	Sitewide
Copper Tubing	2, 3	Type L	Sitewide

PVC polyvinyl chloride

3.1.3 Goal of Pipeline Conveyance Systems

The goal of the pipeline conveyance systems is to convey groundwater from the extraction wells to the treatment plants.

TABLE 3-2

Conveyance System Valves

Valve Type	Valve Size (inches)	Manufacturer	Specification	Connection Type
GV	8	American Flow Control	Series 500	FL x MJ
BFV	16, 24	Pratt	AWWA C504	–
Combination Air Valves	3	APCO	147C	–
Corporation Stops	2	Ford Meter Box Company	FB1700-7	MIPT x FIPT
PRV	10	Bermad	Model 730	FL x MJ

AWWA American Water Works Association
BFV butterfly valve
FL x MJ flange to mechanical joint
GV gate valve
MIPT x FIPT male iron pipe thread to female iron pipe thread
/PRV pressure-reducing valve

3.2 COMPONENTS

The various valves, pipes, and fittings comprised by the pipeline conveyance system are discussed in this subsection.

3.2.1 Gate Valves

A GV is a wedge perpendicular to the flow; a screw raises and lowers the wedge to permit or prevent flow. The gate valve is used as an on/off valve or to modulate flow.

3.2.2 Butterfly Valves

A BFV is a disk perpendicular to the flow that is mounted on a shaft that is rotated by a geared wheel or locking lever. It is used as an on/off valve or to modulate flow.

3.2.3 Combination Air Valves

Combination air valves are used at high points in the pipeline to let air pockets escape to increase operating efficiency. These valves also allow air into the pipeline when the pipe is drained to prevent excessive negative pressure buildup, which could cause pipe collapse (see Appendix D, Photo 8).

3.2.4 Pressure-Reducing Valve

A pressure-reducing valve is used at the 17th Street Plant to allow water from the 17th Street Plant to be pumped to the Waterman Plant at a constant hydraulic grade line (see Appendix D, Photo 9).

3.2.5 Pipe and Pipe Fittings

DI Pipe and Fittings. All raw water pipelines and fittings are made of pressure class 50 DI. Bell and spigot pipe is used with mechanical restraints where applicable.

Polyvinyl Chloride (PVC) Pipe. All drain piping is C-900 pressure class 150 pounds per square inch (psi). This piping is also bell and spigot pipe with mechanical restraints where applicable; the fittings are DI.

3.2.6 Blow-Off Valves

Blow-off valves are located at low points along the pipeline; they are placed at pre-determined intervals to drain and flush the pipeline (see Appendix D, Photo 10).

3.3 OPERATION

The following section describes the operating procedures for the pipeline conveyance system.

3.3.1 Initial/Post-Maintenance Startup Procedures

During initial/post-maintenance startup:

1. Fully open all mainline valves in the maintenance-affected area.
2. Close valves at extraction wells.
3. Open blow-off valves to allow air to purge from the pipes.
4. Connect a fresh water source (e.g., a fire hydrant) to an existing blow-off valve assembly and slowly fill the pipeline with fresh water. Close blow-off valves as air is displaced by fresh water in the pipeline. Sections of the pipeline between isolation valves may be filled individually.
5. Pressure test the pipeline for leaks. Once the pipeline is deemed leakproof, chlorinate it with a chlorine gas-water mixture of 50 milligrams per liter (mg/L) to 80 mg/L of dry chlorine gas.
6. Using fresh water, flush the pipeline with the equivalent of one pipeline volume at a minimum velocity of 3 feet per second.
7. Disconnect the fresh water supply and ready the system for operation in accordance with Sections 3.3.3, 2.3, and 4.3.

3.3.2 Shutdown Procedures

After the pumps have been shut down, the valves listed in Table 3-3 should be moved to the closed position until the system is ready to be restarted. For details, see Figure 3-3.

3.3.3 Normal Operating Procedures

During normal operation, all valves should be positioned according to Tables 3-4 and 3-5 for the North and South Plants, respectively. Open valves should be 100 percent open during normal operation. The valve positions for startup, bypass to drain, and bypass of the 17th Street Plant also are provided in Tables 3-4 and 3-5 for the North and South Plants, respectively. For details see Figures 3-1 and 3-3.

Descriptions for reduced capacity operation, disinfection, flushing and testing, and emergency operating procedures are presented in the sections following Table 3-5.

3.3.3.1 Reduced Capacity Operation

Reduced capacity operation will be achieved when the extraction wells are operating at reduced capacity and will impact conveyance system operating conditions. For instance, the fluid velocity in the pipe will be less than the full capacity value, and the pressure drop caused by friction between the pipe wall and pipe fittings

TABLE 3-3

Pump Shutdown Schedule

Valve ID	Valve Type/ Diameter (inches)	Valve Location	Shutdown Position
EW-1			
005-296	GV/ 12	11th Street between Mayfield and Arrowhead (by EW-2)	Closed
005-298	GV/ 12	11th Street between Mayfield and Arrowhead (by EW-2)	Closed
EW-2			
005-295	GV/ 12	11th Street between Mayfield and Arrowhead	Closed
005-294	GV/ 12	11th Street between Mayfield and Arrowhead	Closed
EW-3			
005-291	BFV/ 16	Corner Mountain View and 11th Street, northwestern corner	Closed
005-292	BFV/ 16	Corner Mountain View and 11th Street, northwestern corner	Closed
005-290	GV/ 16	Corner Mountain View and 11th Street, northwestern corner	Closed
EW-4			
005-288	GV/ 12	Corner Mountain View and 11th Street, northwestern corner	Closed
005-287	GV/ 12	Corner Mountain View and 11th Street, northwestern corner	Closed
EW-5			
005-283	BO/ 6	11th Street between Sepulveda and Wall	Closed
005-284	GV/12	Corner Maintain View and 11th Street, northwestern corner (by EW-4)	Closed
005-285	GV/12	Corner Maintain View and 11th Street, northwestern corner (by EW-4)	Closed

BO blow-off valve
BFV butterfly valve
EW extraction well
GV gate valve

and the water will be reduced. The combination air-release valves will still allow air to be purged from the system so the conveyance pipeline will remain flooded.

3.3.3.2 Disinfection

See specification Section 02660, SS. 3.7 “Disinfection of Mains” from the *Project Manual for the Construction of 30-Inch Temporary Waste Pipeline, Muscoy R.D.* (URS, 2000).

3.3.3.3 Flushing and Testing

See specification Section 02660, SS. 3.9 “Flushing of Mains” from the *Project Manual for the Construction of 30-Inch Temporary Waste Pipeline, Muscoy R.D.* (URS, 2000).

TABLE 3-4

North Plant Pipeline Valve Summary

Valve ID*	Valve Type/ Diameter (inches)	Valve Location	Startup Position	Normal Position	Bypass to Drain
027-175	BO/ 6	Western Avenue, south of flood control channel	Open	Closed	Closed
027-176	GV/ 12	Western Avenue	Open	Open	Open
027-177	GV/ 12	Western Avenue	Open	Closed	Open
027-178	GV/ 12	Western Avenue	Open	Open	Closed
027-182	GV/ 16	Western Avenue	Open	Open	Closed
027-181	GV/ 16	Western Avenue	Open	Closed	Closed
027-180	BO/ 6	Western Avenue	Open	Closed	Open
027-184	GV/ 12	Western Avenue	Open	Open	Closed
028-169	BO/ 6	Western Avenue	Open	Closed	Open

* Valve ID numbers are referenced to drawings provided in the *City of San Bernardino Gate Book* (SBMWD, Undated).

BO blow-off valve
GV gate valve

TABLE 3-5

South Plant Pipeline Valve Summary

Valve ID*	Valve Type/ Diameter (inches)	Valve Location	Startup Position	Normal Position	Bypass to Drain	Bypass 17th Street Plant
005-296	GV/ 12	11th Street between Mayfield and Arrowhead (by EW-2)	Open	Open	Closed	NA
005-298	GV/ 12	11th Street between Mayfield and Arrowhead (by EW-2)	Open	Closed	Open	NA
005-295	GV/ 12	11th Street between Mayfield and Arrowhead (by EW-2)	Open	Open	Closed	NA
005-294	GV/ 12	11th Street between Mayfield and Arrowhead (by EW-2)	Open	Closed	Open	NA
005-291	BFV/ 16	Corner Mountain View and 11th Street, northwestern corner (by EW-3)	Open	Open	Closed	Open
005-292	BFV/ 16	Corner Mountain View and 11th Street, northwestern corner (by EW-3)	Open	Closed	Closed	Open
005-290	GV/ 16	Corner Mountain View and 11th Street, northwestern corner (by EW-3)	Open	Closed	Open	Closed

TABLE 3-5 (Continued)

Valve ID*	Valve Type/ Diameter (inches)	Valve Location	Startup Position	Normal Position	Bypass to Drain	Bypass 17th Street Plant
005-288	GV/ 12	Corner Sierra Way and 11th Street, southwestern corner, 300 Block (by EW-4)	Open	Open	Closed	NA
005-287	GV/ 12	Corner Sierra Way and 11th Street, southwestern corner, 300 Block (by EW-4)	Open	Closed	Open	NA
005-284	GV/ 12	Corner Sierra Way and 11th Street, southwestern corner, 300 Block (by EW-4)	Open	Open	Closed	NA
005-285	GV/ 12	Corner Sierra Way and 11th Street, southwestern corner, 300 Block (by EW-4)	Open	Closed	Open	NA
005-283	BO/ 6	Northern side of 11th Street, between Wall Ave. and Sepulveda Ave.	Open	Closed	Closed	Closed
005-278	BFV/ 24	1200 Block Mountain View, south of 13th Street intersection	Open	Open	NA	NA
005-277	BO/ 6	1200 Block Mountain View, south of 13th Street intersection	Open	Closed	Closed	Closed
005-281	BFV/ 16	1200 Block Mountain View, north of Baseline intersection	Open	Open	NA	Closed
005-280	BO/ 6	1200 Block Mountain View, north of Baseline intersection	Open	Closed	Closed	Closed
006-337	BFV/ 16	1500 Block Mountain View, north of Magnolia intersection	Open	Open	NA	NA
006-336	BO/ 6	1500 Block Mountain View, north of Magnolia intersection	Open	Closed	Closed	Closed
006-331	BFV/ 24	200 Block West 17th Street, east of Mountain View intersection	Open	Open	Open	Open
006-334	BFV/ 24	1500 Block Mountain View, south of 16th Street intersection	Open	Open	NA	NA
006-333	BO/ 6	1500 Block Mountain View, south of 16th Street intersection	Open	Closed	Closed	Closed
006-325	BFV/24	2000 Block Mountain View, south of 21st Street intersection	Open	Closed	N/A	N/A
006-327	BFV/ 24	PRV Station, intersection Mountain View and 17th Street	Open	Closed	NA	NA
006-328	BFV/ 24	200 Block West 17th Street	Open	Closed	NA	NA
006-330	BFV/ 24	200 Block West 17th Street	Closed	Closed	NA	NA
006-324	BO/6	2000 Block Mountain View, south of 21st Street intersection	Open	Closed	Closed	Closed
007-263	BO/ 6	2500 Block Mountain View, near 26th Street	Open	Closed	Closed	Closed

TABLE 3-5 (Continued)

Valve ID*	Valve Type/ Diameter (inches)	Valve Location	Startup Position	Normal Position	Bypass to Drain	Bypass 17th Street Plant
007-264	BFV/ 24	2500 Block Mountain View, near 26th Street	Open	Open	NA	NA
007-260	BO/6	2900 Block Mountain View, near 29th Street	Open	Closed	Closed	Closed
007-261	BFV/ 20	2900 Block Mountain View, near 29th Street	Open	Open	NA	NA
007-257	BO/ 6	200 Block Marshall Blvd., intersection Sierra Way	Open	Closed	Closed	Closed
007-258	BFV/ 20	200 Block Marshall Blvd., intersection Sierra Way	Open	Open	NA	NA
008-305	BO/ 6	3000 Block N. Leroy	Open	Closed	Closed	Closed
008-306	BFV/24	3000 Block N. Leroy	Open	Open	N/A	N/A
007-267	BO/6	Leroy, near SBMWD Reservoir	Open	Closed	Closed	Closed

* Valve ID numbers are referenced to drawings provided from the *City of San Bernardino Gate Book* (SBMWD, Undated).

BFV	butterfly valve
BO	blow-off valve
EW	extraction well
GV	gate valve
NA	not applicable
PRV	pressure-reducing valve
SBMWD	San Bernardino Municipal Water District

3.3.3.4 Emergency Operating Procedures

During an emergency shutdown, all well isolation valves indicated in Table 3-3 should be in the "shutdown" position. Valves should be moved through their full range of motion following the shutdown to ensure operability before the groundwater pumps are restarted.

3.3.4 Troubleshooting

See SBMWD O&M Manual (SBMWD, In Preparation).

3.4 MAINTENANCE

The following subsections describe the maintenance procedures for the pipeline conveyance system. Maintenance records will be kept on file at the system operator’s office and will include inspection and maintenance logs, reports of system shutdowns and repairs, monthly records of the volume of water processed, and analytical results for any water samples collected from the system.

3.4.1 Site Maintenance

Site maintenance will include keeping valve gear boxes, manholes, and vaults clear and accessible for inspection, maintenance, and repair. Garbage, weeds, and gravel will be cleared annually from the valve gear boxes, manholes, and vaults.

Asphalt will be inspected annually and patched as necessary. A surface visual inspection for leaks will be performed concurrently with the asphalt inspection. Pipes will be repaired if leaks are found.

Above-grade facilities will be repainted every five years, at a minimum. Repaired components will be repainted when repairs are completed.

3.4.2 Component Maintenance

Components involved in the pipeline conveyance system maintenance program are presented hereafter. Above-grade appurtenances will be repainted every five years, at a minimum. Repaired components will be repainted when repairs are completed.

3.4.2.1 Gate Valves

GVs will be exercised every three years. The Gvs should be fully closed and opened to ensure the full movement and function of the gearbox. GV covers will be inspected annually, raised to grade, and repainted, as necessary.

3.4.2.2 Blow-Off Valves

Blow-off valves will be inspected every three years for operability. Malfunctioning valves will be repaired or replaced, as necessary.

3.4.2.3 Air-Release Valves

Air-release valves will be inspected every three years for operability. Malfunctioning valves will be repaired or replaced, as necessary.

3.5 REMEDY CONFORMANCE

If the sum of the extraction well flows is statistically equal to the influent to the treatment plants, then the pipeline conveyance system is conveying all extracted groundwater to the treatment plants. This result confirms the conformance of the remedy for the pipeline conveyance system.

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4.0 TREATMENT PLANT SYSTEMS

This section describes the OMP of the treatment plant systems and their components. Figures 4-1 through 4-8 illustrate the mechanical, chemical, electrical, and hydraulic gradient details of the North and Waterman Plants. Figures 4-9, 4-10, and 4-11 present a flow diagram for the granular activated carbon (GAC) adsorber systems, carbon filter panel PLC diagram, and details of the carbon filter monitor panels, respectively, for those two plants. Figures 4-12 through 4-15 illustrate the mechanical, chemical, electrical, and hydraulic gradient details of the 17th Street Plant.

4.1 DESCRIPTION

The treatment plants incorporate the equipment between the conveyance piping and the connection to the SBMWD reservoirs. The North Plant and the Waterman Plant are described in detail in this section; the 17th Street Plant is not described in detail because it was not constructed by the U.S. EPA, nor does it use the same plant layout. The air strippers at the treatment plants are used only to meet peak demands or to provide backup to the GAC plants; they are not discussed further in this section because they are not U.S. EPA equipment.

4.1.1 Treatment Plants

4.1.1.1 North Plant

The North Plant treats water from EW-6, EW-7, and Newmark-3 and discharges the treated groundwater into SBMWD reservoirs. Extracted groundwater can be treated using GAC and/or air stripping towers to remove contaminants. The North Plant was designed to treat up to 5,250 gallons per minute (gpm) (7.56 million gallons per day [mgd]) of extracted groundwater using 7 pairs of GAC units operated in parallel, with each pair operated in series. Construction details for the North Plant are provided in Section 4.1.2.1 (See Appendix D, Photo 11).

4.1.1.2 Waterman Plant

The Waterman Plant treats water from EW-1, EW-2, EW-4, and EW-5 and discharges the treated groundwater into SBMWD reservoirs. Extracted groundwater can be treated using GAC and/or air stripping towers to remove contaminants. The Waterman Plant was designed to treat up to 6,000 gpm (8.64 mgd) of extracted groundwater using 8 pairs of GAC units operated in parallel, with each pair operated in series. Construction details for the Waterman Plant are provided in Section 4.1.2.2 (see Appendix D, Photo 12).

4.1.2 Construction of the Treatment Plants

The following sections provide construction details for the North Plant and the Waterman Plant.

4.1.2.1 North Plant

The extracted water pipeline is connected to the treatment plant raw water inlet header via a cross pipe fitting. The cross empties into one of three branches. One branch is blind-flanged for a future bypass directly to the reservoir; another branch connects to SBMWD EW-4; and the third branch goes to the treatment plant inlet header.

The treatment plant inlet header is a manifold that distributes the raw water to the seven pairs of GAC vessels that treat it. In each GAC vessel pair, the raw water enters the top of the primary or lead vessel for treatment, exits through screens in the bottom of the vessel, then flows to the top of the secondary or lag vessel for polish treatment. Treated waters exit the lag vessel through screens to the treated water header. The treated water header directs the treated water through an in-line chlorine injection system and a flow meter and then through a pressure-sustaining valve (PSV) and an anti-siphon loop. After the anti-siphon loop, the treated water flows to the SBMWD reservoir.

To meet peak demands and to provide backup to the GAC vessels, the end of the inlet header connects to the air stripping tower inlet piping through a 16- by 24-inch diameter reducer and a BFV. See Figure 4-1 for details.

4.1.2.2 Waterman Plant

The extracted groundwater enters the treatment plant inlet at a tee. Two BFVs, BFV-3 and BFV-4, are on the downstream sides of the tee. BFV-4 (which is normally open) directs extracted water to the GAC treatment plant raw water inlet header, and BFV-3 (which is normally closed) directs raw water to two existing air strippers for treatment, if necessary. Upstream from these BFVs is a bypass constructed of tees and a removable spool piece. The bypass is included so that once remediation is complete, water from the wells can go directly to the SBMWD reservoir without first going through the treatment plant. See Figure 4-5 for details.

The inlet header is a manifold that distributes the raw water to the eight pairs of GAC vessels that treat it. In each GAC vessel pair, the raw water enters the top of the primary or lead vessel for treatment, exits through screens in the bottom of the vessel, then flows to the top of the secondary or lag vessel for polish treatment. Treated waters exit the lag vessel through screens to the treated water header. The treated water header directs the treated water through an in-line chlorine injection system and a flow meter and then through a PSV and an anti-siphon loop. After the anti-siphon loop, the treated water flows through BFV-1, a tee, and BFV-2 and then to the SBMWD reservoir. The branch of the tee situated between the two BFVs is blind-flanged and will complete the aforementioned bypass.

4.1.3 Goal of the Treatment Plant Systems

The goal for all of the treatment plants, as stated in the DHS permit, is to treat groundwater so that “effluent from all GAC . . . treatment sites shall not exceed applicable MCLs or Action Levels for all constituents of concern, except TCE and PCE, which will be non-detect” (DHS, 1999).

4.2 COMPONENTS

The treatment system components are discussed in this section.

4.2.1 Valves

The GAC vessel valves are labeled on Figure 4-9 for one pair of GAC vessels (1A and 1B). Valve labeling for other GAC vessel pairs is identical to the valve labeling for this GAC vessel pair. Details of the valves in the GAC vessels and in the influent and effluent header pipes are described hereafter (see Appendix D, Photo 13).

4.2.1.1 Pressure-Sustaining Valve (PSV)

The water extracted from the aquifers beneath San Bernardino contains excessive dissolved gases. These gases, coming out of solution within the GAC vessels, could cause air binding of the vessels and short circuiting of fluid flow, resulting in incomplete treatment and inefficient system operation. PSV-1 is provided in the effluent (treated water) header upstream from the anti-siphon loop to maintain sufficient pressure in the GAC vessels to keep the dissolved gases in solution as they pass through the treatment process. The volume of dissolved gases changes seasonally, and the PSV may need periodic adjustment. The PSV is operator-adjustable and should be set at approximately 3 psi higher than the minimum pressure that will result in no perceptible buildup of gases in the GAC vessels. This setting will maximize the operability of the system with a minimal increase in energy consumption (see Appendix D, Photo 14).

4.2.1.2 Isolation Valves

Isolation valves are provided to isolate pieces of equipment so that they can be taken out of service for maintenance purposes. All of the isolation valves on the influent and effluent header pipes and on the GAC vessels are BFVs that are used to route the water to and from the treatment plant and through the GAC vessels.

Valve details for vessel pair 1A/1B are provided in Table 4-1. Remaining vessel pairs have valves identical to 1A/1B. See Figure 4-9 for details.

TABLE 4-1

Isolation Valves

Valve Label	Location	Type	Size (inches)	Equipment Isolate/Flow Control
1A-BFV-1	GAC Vessel 1A	Butterfly	8	GAC Vessel 1A/spent backwash water
1A-BFV-2	GAC Vessel 1A	Butterfly	8	GAC Vessel 1A/influent water
1A-BFV-3	GAC Vessel 1A	Butterfly	8	GAC Vessel 1A/inlet from GAC Vessel 1B
1A-BFV-4	GAC Vessel 1A	Butterfly	8	GAC Vessel 1A/outlet to GAC Vessel 1B
1A-BFV-5	GAC Vessel 1A	Butterfly	8	GAC Vessel 1A/effluent water
1A-BFV-6	GAC Vessel 1A	Butterfly	8	GAC Vessel 1A/backwash water
1B-BFV-1	GAC Vessel 1B	Butterfly	8	GAC Vessel 1B/spent backwash water
1B-BFV-2	GAC Vessel 1B	Butterfly	8	GAC Vessel 1B/influent water
1B-BFV-3	GAC Vessel 1B	Butterfly	8	GAC Vessel 1B/inlet from GAC Vessel 1A
1B-BFV-4	GAC Vessel 1B	Butterfly	8	GAC Vessel 1B/outlet to GAC Vessel 1A
1B-BFV-5	GAC Vessel 1B	Butterfly	8	GAC Vessel 1B/effluent water
1B-BFV-6	GAC Vessel 1B	Butterfly	8	GAC Vessel 1B/backwash water
Sequence repeats for each vessel pair				
BFV-3*	Stripper Inter-tie	Butterfly	24	Isolates air strippers from treatment system
BFV-4*	Raw Water	Butterfly	24	Isolates all raw (influent) water from system
PSV-1	Plant Discharge			PSV
GV-1	Backwash Waste	Gate	12	Isolates backwash waste sumps

* Waterman Plant Only

BFV butterfly valve
GAC granular activated carbon
GV gate valve
PSV pressure-sustaining valve

4.2.1.3 Water Sampling Valves

Water sampling valves are used to sample water at various points throughout the treatment plant. The water samples are collected at different points to determine the concentration of contaminants in the water as it passes through the treatment process. Contaminant concentration information is used to determine the breakthrough of the carbon in the vessels and to comply with the treatment standards. Water sampling valve details for vessel pair 1A/1B are provided in Table 4-2. Remaining vessel pairs have valves identical to 1A/1B (see Appendix D, Photo 15).

TABLE 4-2

Water Sampling Valves

Valve Label	Location	Size (inches)	Type
1A-ST-1	GAC Vessel 1A 25%*	½	Brass ball valve
1A-ST-2	GAC Vessel 1A 50%*	½	Brass ball valve
1A-ST-3	GAC Vessel 1A 75%*	½	Brass ball valve
1A-ST-4	GAC Vessel 1A raw water line	½	Brass ball valve
1A-ST-5	GAC Vessel 1A effluent	½	Brass ball valve
1B-ST-1	GAC Vessel 1B 25%*	½	Brass ball valve
1B-ST-2	GAC Vessel 1B 50%*	½	Brass ball valve
1B-ST-3	GAC Vessel 1B 75%*	½	Brass ball valve
1B-ST-4	GAC Vessel 1B raw water line	½	Brass ball valve
1B-ST-5	GAC Vessel 1B effluent	½	Brass ball valve
Sequence repeats for each vessel pair			
ST-6**	Effluent pipe at flow meter	½	Brass ball valve

* 25%, 50%, and 75% represent respective heights of the GAC vessel where sample valves are located.
** Waterman Plant only

GAC granular activated carbon

The water samples collected at the 25%, 50%, and 75% heights on the GAC vessels are used to evaluate the progress of carbon breakthrough over time. Additional details are provided in Subsection 4.2.6 and on Figure 4-9.

4.2.1.4 Air/Vacuum-Release Valves

Air/vacuum release valves allow large volumes of air to be exhausted from or admitted into the pipeline or carbon vessel to improve pipeline efficiency and to protect equipment. These valves are provided at the top and bottom of each carbon unit and at the highest point of the anti-siphon loop on the effluent pipe. Air/vacuum release valve details for vessel pair 1A/1B are provided in Table 4-3. Remaining vessel pairs have valves identical to 1A/1B (see Appendix D, Photos 16 and 17).

4.2.2 GAC Units

The North Plant has seven pairs and the Waterman Plant has eight pairs of skid-mounted GAC adsorption vessels. Each vessel contains 20,000 pounds of GAC. The entire GAC vessel package, including piping manifold, instrumentation, and valves, was supplied and installed by Northwestern Carbon of Red Bluff, California. Table 4-4 presents GAC design details, and Table A-1 presents components of the GAC units. Each GAC pair is equipped with manifolds and valves to allow for either in-series (double-pass) or parallel (single-pass) operation and backwashing flow configuration. Each pair is operated in series under normal operating conditions. An empty-bed hydraulic contact time of 15 minutes is required to maintain a high degree of reliability in reaching quality requirements for discharge water. Flow through each vessel should be maintained below 750 gpm to minimize pressure drop across the vessels and to prevent short-circuiting in the GAC bed. The carbon vessels are rated at 75 pounds per square inch gauge (psig), and the connected piping is rated at 125 psig. The pressure drop across each vessel at 637 gpm is estimated to be 2.3 psi, or 5.3

TABLE 4-3

Air/Vacuum-Release Valves

Valve Label	Location	Size (inches)	Discharge Point
1A-VPR-1	Top of GAC Vessel 1A	2	Atmosphere
1A-VPR-2	Bottom of GAC Vessel 1A	1	Atmosphere
1B-VPR-1	Top of GAC Vessel 1B	2	Atmosphere
1B-VPR-2	Bottom of GAC Vessel 1B	1	Atmosphere
Sequence repeats for each vessel pair			
VPR-2	Anti-Siphon Loop	2	Atmosphere

GAC granular activated carbon
VPR vacuum/pressure release

feet of water column (see Appendix B). A rupture disk assembly is provided to protect each vessel from over pressurization. The carbon vessels are built of mild steel that has been externally primed and painted and internally coated with vinyl ester (see Appendix D, Photo 18).

Extracted water passes from the raw water inlet header into the top of each lead vessel in the pair. The extracted water flows downward through the lead vessel, empties out from the bottom of the lead vessel, and then flows into the top of the lag vessel. The extracted water then flows downward through the lag vessel and empties out from the bottom of the lag vessel into the treated water header that eventually directs the treated water into a nearby SBMWD water reservoir.

The GAC vessels are equipped with automated safety features, and treatment plant operation is interlocked with the existing control panel. The treatment plant instrumentation includes pressure gauges, pressure sensors, rupture disks, flow totalizers, and alarms.

4.2.3 Chlorination System

The Waterman and North Plants use a dual-tank, auto-switch-over, flow-paced gas chlorination system to maintain a 0.5-mg/L chlorine residual in the treated effluent. The system uses two on-site 150-pound chlorine cylinders, on separate scales, with a manually set flow-paced dosage control set to 0.5 mg/L. The chlorine feed system automatically adjusts chlorine feed to match the flow rate in the treatment process. The chlorine dose averages 0.2 to 0.8 mg/L. The chlorine residual is checked manually three times daily to ensure that the system is operating correctly (see Appendix D, Photo 19).

4.2.4 Pressure Monitoring and Control

Each GAC vessel is equipped with two pressure gauges and a differential pressure transmitter. Pressure differential is measured between the inlet and the outlet pipe of each vessel. An increase in pressure differential indicates mechanical fouling of the carbon beds caused by the accumulation of incidental solids. When the differential pressure is greater than 5 psi or lower than 0 psi, an alarm notifies operators of changes in vessel pressure. Each vessel is equipped with a rupture disk to protect the vessel from over-pressurization. The disk will burst at 75 psig (see Appendix D, Photos 20 and 21).

TABLE 4-4

GAC Design Basis for North Plant and Waterman Plant

GAC Component	Plant Details
Carbon System	
Carbon Unit Type	Northwestern Carbon HP-1020
Number of Carbon Units	7 parallel pair systems/8 parallel pair systems
Carbon Units Operating Mode	Each pair in the system is normally operated in series, though each pair can be run in parallel
Total Design Flow Rate (gpm)	4,875 / 5,100
Design Flow Rate per Pair (gpm)	696 / 637
Maximum Flow Rate per Pair (gpm)	750
Weight of Carbon per Unit (lbs)	20000
Estimated Carbon Usage Rate (lbs/day)	445
Estimated Carbon Life (days)	360
Diameter per Vessel (feet)	10
Carbon Unit Height (feet)	~20
Carbon Unit Shipping Weight (per pair) (lb)	48000
Carbon Unit Weight (operating, per pair) (lb)	253000
Carbon Volume per Unit (ft^3)	714
Connection	ANSI 8-inch pipe flange
Carbon Unit Pressure Rating (psig)	75
Unit Material	Mild steel
External Coating	Prime and paint
Internal Coating	Epoxy
Piping Material	Steel Schedule 40
Backwash Type	Manual valve
Carbon	
Type of Carbon	Virgin or reactivated Filtrasorb 300, or approved equivalent
Apparent Density (lb/ft^3)	28 to 32
Pore Volume (cm^3/g)	0.85
U.S. Standard Sieve Size	8 x 30
Larger than No. 8, maximum	15%
Smaller than No. 30, maximum	5%
Effective Particle Size (mm)	0.8 to 1.0

TABLE 4-4 (Continued)

GAC Component	Plant Details
Moisture, maximum	2%
Iodine Number (AWWA)	900 (minimum)
Abrasion Number, minimum	75
Uniformity coefficient, maximum	2.1
Backwash	
Maximum Flow (gpm)	1500
Time (minutes)	15
Volume (gallons)	22,500 (3,000 ft^3)
Electrical (Controls)	
Requirements	120 volts, single phase
Location	Existing transformer/control room
Emergency Power	None

ANSI	American National Standards Institute
AWWA	American Water Works Association
cm^3/g	cubic centimeters per gram
ft^3	cubic foot
GAC	granular activated carbon
gpm	gallons per minute
lb	pound
mm	millimeters
psig	pounds per square inch gauge

4.2.5 Flow Meters

Flow meters are used to keep track of the amount of water that passes through the system. They were supplied by the SBMWD for installation by the contractor.

Each pair of vessels is equipped with a propeller flow meter in the treated water line, between the vessel outlet and the treated water header. A second propeller flow meter is installed in the backwash water supply line to keep track of the volume of City water used for backwashing. Another propeller flow meter is provided on the effluent header to the reservoir before the anti-siphon loop. This flow meter quantifies the total amount of discharged treated water and is interlocked with the chlorination system for the automatic adjustment of the chlorine dosage (see Appendix D, Photos 22 and 23).

4.2.6 Carbon Vessel Sampling Ports

Each pair of carbon vessels is operated in series. The first vessel in the pair is called the lead vessel; the second vessel is called the lag vessel. Each vessel is provided with water sampling ports at the inlet and outlet. Samples collected from the inlet and outlet of the lead vessel are analyzed to detect the breakthrough of carbon in the lead vessel. The lead vessel should be scheduled for change-out when carbon breakthrough is identified.

Three additional sampling ports are provided on each vessel at 25%, 50%, and 75% of the height of the carbon bed to collect water samples and monitor the remaining carbon capacity prior to breakthrough. Each vessel also is provided with a carbon sampling port for the collection of carbon grab samples from the vessel to monitor the chemical characteristics of the carbon in the vessel. Table 4-5 presents the carbon sampling valves or ports for vessel pair 1A/1B. The other vessel pairs have sampling valves identical to 1A/1B (see Appendix D, Photos 24, 25, and 26).

TABLE 4-5

Carbon Sampling Valves or Ports

Valve or Port Label	Location	Size (inches)	Type
1A-CS-1	GAC Vessel 1A	2	Brass ball valve
1B-CS-1	GAC Vessel 1B	1	Brass ball valve

CS carbon sample
GAC granular activated carbon

Each vessel is provided with a 4-inch diameter pipe outlet at the bottom of the vessel for emptying the spent carbon. Standard American Society of Mechanical Engineers (ASME) designed heads were used on the top and bottom of each vessel to facilitate complete emptying of the spent carbon. A 4-inch diameter vertical fill pipe is provided with each vessel to charge the vessel with fresh carbon. See Section 4.4.3.1 for a description of the carbon replacement procedures.

4.2.7 Backwash System

Water extracted from the newer extraction wells (EW-1 through EW-7) is expected to be low in silt and other solids. However, the GAC vessels may experience an increase in pressure drop across the bed of carbon, which indicates mechanical fouling by accumulated incidental solids. If this happens, the vessel will be taken offline, and the flow through the vessel will be reversed. The purpose of reversing the flow is to expand the carbon bed, which facilitates the dislocation of accumulated solids. The flow rate will be adjusted to achieve sufficient force to dislocate the solids and flush them into the spent backwash sump.

Backwash water for the North Plant is provided by an existing treated water supply. The water flows through a flow meter and backflow preventer to the 8-inch diameter backwash supply header to the plant. Backwash water to the Waterman Plant is provided by an existing 20-inch diameter municipal system water line. An 8-inch diameter pipe header connected to the existing 20-inch diameter water line brings the backwash water to the Waterman Plant. A backflow preventer and a flow meter are provided in the 8-inch diameter backwash line to the Waterman Plant. For both plants, the backwash flow rate will be 800 gpm, with a maximum of 1,500 gpm; this rate is adjustable by BFVs at each vessel pair.

The spent backwash water generated during a backwash cycle will be collected in two sumps, one along each GAC treatment train. The two sumps are connected by a 12-inch diameter pipeline. The sump system is designed to hold the backwash volume of one vessel at a flow rate of 1,500 gpm for 15 minutes, or a total volume of 22,500 gallons (approximately 3,000 cubic feet). The approximate volume of each sump is as follows:

- North Plant, North Drain Channel 13,306 gallons
- North Plant, South Drain Channel 18,088 gallons
- Waterman Plant, North Drain Channel 18,088 gallons
- Waterman Plant, West Drain Channel 18,088 gallons
- 17th Street Plant, Drain Channel 8,000 gallons

It should be noted that one backwash uses approximately 22,500 gallons, but each individual sump does not hold one full backwash.

The sumps are covered with steel grating so that the spent backwash water quality can be monitored visually during a backwash cycle. This allows the operator to reduce the backwash flow rate in case of carbon carry over. The steel grating is rated for 1-ton forklift loading (see Appendix D, Photos 27 and 28).

The spent backwash water at the Waterman Plant drains by gravity through a 12-inch diameter DI pipe to the 15-inch diameter storm sewer system on Leroy Street. A 12-inch diameter GV is provided in the pipe to allow the water to be retained in the backwash waste sump, if required.

The spent backwash water at the North Plant drains by gravity to an adjacent storm water channel.

4.2.8 Alarms

Plant-specific instrumentation and control (I&C) systems monitor process inputs and activate alarms on annunciator panels to inform operations personnel of maintenance and malfunction conditions associated with each GAC vessel.

The operation and control of GAC vessels is manual. The GAC vessels are monitored and alarmed as follows.

- **High Differential Pressure Alarm**. Initiates local and remote warning alarm to indicate carbon maintenance is required.
- **High Differential Pressure Critical Alarm.** Initiates local and remote warning alarm to indicate that vessel shutdown and isolation should be performed.

  Note: The differential pressure alarms are adjustable set points in the PLC. The PLC monitors a 4-20 mA signal from a differential pressure transmitter. Included within the differential pressure transmitter is a local indicator. The indicator is installed on each vessel and provides a local indication of the differential pressure across the vessel.
- **Low-Pressure and Low-Flow Alarm.** Initiates local and remote alarms when low pressure or low flow occurs.
- **Total Flow Transmitters (included for each pair of vessels).** Include instantaneous and totalizing local flow indicators and output for remote telemetry.
- **Flow Transmitter (included at the effluent pipe header to reservoir).** Includes instantaneous and totalizing local flow indicators and output for remote telemetry.

Local alarms are connected to an annunciator panel in the existing control building. The annunciator panel includes visual and audible indicators and normal annunciator functions (acknowledge, flash, test, silence, and seal-in options) (see Appendix D, Photos 29 and 30).

Remote alarm processing is provided by the existing SBMWD SCADA control center at 195 North D Street, which has remote shutdown capabilities. Remote alarms are dry contacts from retransmit relays within the annunciator panel. The remote alarm is terminated in an interface cabinet.

4.2.9 Power Supply

Power requirements for the carbon treatment plant are minimal. The electrical demand is significantly less than was required for the initial air stripper treatment system, which is a three-phase, 60 Hertz, 460-V electrical service. No additional power capacity is needed; power service requirements have been met by modifications to the existing equipment.

Power to the site equipment includes 120-V I&C power (differential pressure transmitters, rupture disk sensors, and flow transmitters) and power to ground-fault circuit interrupter (GFCI)- type duplex receptacles placed at convenient locations among the GAC vessels (see Appendix D, Photos 31 and 32).

The individual components of the treatment plant electrical systems are provided in Table A-2.

4.2.10 Conveyance Pipe Headers

4.2.10.1 Influent

The raw water conveyance pipes to the North and Waterman Plants are 24-inch diameter headers from the tie-in points to the individual GAC vessel pairs. From the 24-inch diameter header, Schedule 40, 8-inch diameter steel pipe is used as the influent piping to the GAC vessel manifolds. The raw water pipe header is below ground. Individual yard piping components are presented in Table A-3.

4.2.10.2 Effluent

Treated water from individual vessel pairs is collected in the 24-inch diameter effluent header. This header conveys the treated water to the drinking water supply reservoir maintained by the SBMWD. A 20-inch diameter anti-siphon loop is provided in the treated water header to keep the GAC vessels full of water during shutdown. The anti-siphon loop is designed to be higher than the top elevation of the GAC vessel. An air/vacuum-release valve at the top of the anti-siphon loop purges entrained gases from the effluent header during operation; during shutdown, it prevents siphoning by allowing air into the effluent header (see Appendix D, Photo 33).

4.2.11 Site Security

A boundary chain-link fence with gates is provided to secure the site. Each site is visited by a plant operator three times daily during operation.

Exterior lights also are provided for site safety purposes. The exterior lighting consists of high-pressure sodium luminaries mounted on poles. Each exterior light includes a photoelectric control. The new lighting fixtures are similar to the existing lighting fixtures.

4.3 OPERATION

The following section describes the operating procedures for the treatment plant systems. It includes initial and routine startup procedures, shutdown procedures, normal operating procedures, including reduced capacity and emergency operation, data collection and SCADA inputs, and troubleshooting procedures. Operating procedures for specific components are provided in the equipment manufacturers' operating instructions, which are included in Volume II of this OMP manual. In addition, treatment plant system operators should operate all GAC treatment units as stated in DHS-approved operation plans.

4.3.1 Initial Startup Procedures

All components must be prepared for startup before the extraction well pumps are activated. Treatment plant startup preparation and startup procedures are performed according to manufacturers' specifications, which are as presented in Volume II of this OMP manual. The preparation and procedure for system startup are outlined hereafter.

4.3.1.1 Startup Preparation

- **Extraction Well Pumps**. Disinfect the wells as outlined in Section 10 of the appropriate SBMWD treatment plant operations plan. Prepare the extraction well pumps for startup as outlined in the SBMWD Operations and Maintenance Manual (SBMWD, In Preparation).

- **Influent Pipeline.** Disinfect and flood the pipeline using the procedure outlined in Section 10 of the *SBMWD Waterman Treatment Plant Operations Plan* (SBMWD, 1998) and in the *SBMWD Operations and Maintenance Manual* (SBMWD, In Preparation)**.**

- **Carbon Vessels**. Follow the vessel manufacturer's operations manual to disinfect empty carbon vessels before loading them with fresh carbon. Before the vessels are brought into service, they must be soaked and then backflushed, according to the manufacturer's instructions. The carbon must be soaked for approximately 24 hours to totally dissipate any entrapped air. The vent lines must be open during the soaking period. Each vessel must be backflushed individually. Preparation should be made to close all of the valves at this stage of preparation. The valves should be set in the vessel manifold as outlined in Table 4-6 to allow for series operation of each pair (see Appendix D, Photo 34).

- **Chlorine System.** Follow the manufacturer's manual for startup instructions (see Appendix D, Photo 35).

TABLE 4-6

Valve Control Chart*

Valve #	Location	Normal Flow	Reverse Flow	Backwash		Bypass	
				First	Second	First	Second
BFV-3	Inlet Pipe	Closed	Closed	Closed	Closed	Closed	Closed
BFV-4	Inlet Pipe	Opened	Opened	Opened	Opened	Opened	Closed
1A-BFV-1	GAC Vessel 1A	Closed	Closed	Opened	Closed	Closed	Closed
1A-BFV-2	GAC Vessel 1A	Opened	Closed	Closed	Closed	Closed	Opened
1A-BFV-3	GAC Vessel 1A	Closed	Opened	Closed	Closed	Closed	Closed
1A-BFV-4	GAC Vessel 1A	Opened	Closed	Opened	Closed	Closed	Closed
1A-BFV-5	GAC Vessel 1A	Closed	Opened	Closed	Closed	Closed	Opened
1A-BFV-6	GAC Vessel 1A	Closed	Closed	Opened	Opened	Closed	Closed
1B-BFV-1	GAC Vessel 1B	Closed	Closed	Closed	Opened	Closed	Closed
1B-BFV-2	GAC Vessel 1B	Closed	Opened	Closed	Closed	Opened	Closed
1B-BFV-3	GAC Vessel 1B	Opened	Closed	Closed	Closed	Closed	Closed
1B-BFV-4	GAC Vessel 1B	Closed	Opened	Closed	Opened	Closed	Closed
1B-BFV-5	GAC Vessel 1B	Opened	Closed	Closed	Closed	Opened	Closed
BFV-1	Effluent Pipe	Opened	Opened	Opened	Opened	Opened	Opened
BFV-2	Effluent Pipe	Opened	Opened	Opened	Opened	Opened	Opened

* Valve control for GAC vessels 2A and 2B, 3A and 3B, 4A and 4B, 5A and 5B, 6A and 6B, 7A and 7B, and 8A and 8B are the same as the valve control configuration for vessel pair 1A and 1B.

BFV butterfly valve
GAC granular activated carbon

4.3.1.2 Startup Procedures

1. Follow the extraction well startup procedures described in Section 2.3.
2. Follow the pipeline conveyance system startup procedures as described in Section 3.3.
3. To initiate operation of the carbon vessels, slowly open the following valves in sequence, allowing time for downstream vessels to fill before opening the next valve: 1A-BFV-2, 1A-BFV-4, 1B-BFV-3. This valve sequence is for the 1A and 1B vessel pair, with 1A as the lead vessel and 1B as the lag. Follow the same sequence for the operation of the other pairs.
4. Open the drain valve in the vessel pair manifold to drain the effluent into the drain channel.
5. Ensure that the flow rate in each vessel pair does not exceed 750 gpm. Adjust the 1A-BFV-2 valve to maintain the flow rate. Initiate additional vessel pairs to accommodate the total flow received by the treatment system while keeping the maximum flow through each vessel pair below 750 gpm.
6. Ensure that the inlet pressure at the carbon vessels does not exceed 75 psig. Throttle the 1A-BFV-2 valve to reduce pressure.
7. Collect appropriate vessel effluent samples and shut down or continue to treat water until laboratory information indicates that no bacteriological or VOC contamination is present.
8. Close the drain valve and slowly open the 1B-BFV-5 valve to allow water from the carbon vessels to enter the effluent pipe header. Walk along the effluent pipe header route and open the BFV-1 and BFV-2 valves. Check the air-release valve located at the anti-siphon loop.
9. Check the effluent pressure at the vessels to ensure that the PSV is maintaining a minimum of 26 psig.
10. Check the chlorination system to make sure it is dispensing the appropriate amount of chlorine (See Section 4.4.3.2 for details).
11. Check the system components for leaks, vibrations, and unusual noises. Monitor flow rates and pressures, and throttle the valves as needed to attain the normal operating parameters (see Table 4-7).
12. Repeat these steps to start up the remaining extraction wells and the remaining vessel pairs.
13. At this stage, all of the extraction wells are operating at predetermined flow rates, all of the vessel pairs are being used for treatment, and the treated water is being discharged into the SBMWD reservoirs.

TABLE 4-7

Normal Operating Parameters

System Component/Instrument	Reading
Flow to each vessel pair*	Approximately 600 gpm
Carbon vessels differential pressure	Less than or equal to 4.5 psi per pair
Effluent pipe tie-in pressure	26 psig

* Actual flow to each vessel pair will vary. No single pair should vary by more than ±5 percent from the average flow (North Plant average flow = total flow/7; Waterman Plant average flow = total flow/ 8).

gpm gallons per minute
psi pounds per square inch
psig pounds per square inch gauge

During startup, all gauges, controls, flow meters, valves, and piping will be inspected for proper performance. Any malfunction or leaks should be corrected immediately. When the startup sequence is completed, the plant should operate as defined in Subsection 4.3.3.

4.3.2 Shutdown Procedures

Periodic maintenance may require a plant shutdown. The plant operator should notify the U.S. EPA of any plant shutdown that exceeds 48 hours. Procedures for scheduled plant shutdowns are described hereafter.

1. Shut down the extraction pumps.
2. Shut off the water supply to the treatment plant by closing influent header valve BFV-4. To ensure that the vessels remain full of water, close effluent header valve BFV-1 and/or BFV-2.
3. Turn off the chlorination system.
4. Turn the plant control panel to the off position.

4.3.3 Normal Operating Procedures

The valve positions under normal operating conditions are shown in Table 4-6. After startup, the valve positions will be set for normal operation.

4.3.3.1 Reduced Capacity Operation

The North Plant operating capacity can be reduced by partially closing BFVs at the individual extraction wells. The South Plant extraction pumps are equipped with variable speed drives that allow each of them to operate at a range of 1,500 to 2,000 gpm. Before throttling the extraction pump below the design flow rate, consult the manufacturer's instructions (provided in Volume II of this manual) to determine the proper operating pressure head and flow rate range for the pump. Vessel pairs will be able to receive reduced flow rates. However, if the flow rates in each vessel pair are low, some pairs can be throttled back to keep the maximum number of vessel pairs operating at their normal flow rates.

Do not throttle any pairs of vessels to zero flow. To control bacteria growth, always keep a minimum “flushing” flow running through all vessel pairs if carbon is present in the vessel. Ensure that the pressure at the effluent header is maintained at a minimum of 26 psi at reduced operation. The chlorination system and effluent PSV will self-adjust for the reduced flow rate.

4.3.3.2 Emergency Operating Procedures

Emergencies, such as power failures, mechanical failures, and natural disasters (flooding, fire, and earthquake), may disrupt normal daily operation. In an emergency, the system operator can follow the standard SBMWD operating procedure to take appropriate corrective actions to restore the system to normal operation.

4.3.4 Data Collection and SCADA Inputs (Treatment Plants)

Various process signals are taken from the existing control system and used as inputs for a centralized SCADA system. The SCADA system uses PLC output cards at the treatment plant control panels to send the process signals to the SCADA main collection center in the City offices.

The SCADA inputs use the analog process signal (typically 4-20 mA) wired into new terminal blocks and then routed through signal isolators. The signal isolators produce a “clean” analog signal that is input to the PLC unit. The PLC processes the signal and verifies whether the signal is out of typical boundary values. If the signal indicates a problem with the process, an alarm signal is generated in the PLC; it notifies the operator by lighting a local alarm panel (for the carbon filter systems).

Process analog input signals to the PLC include water flow rates and carbon differential pressures. The local PLC processes the analog signals and sends the signals, via a PLC-SCADA communication cable, to the SCADA system. The SCADA system monitors all PLC data and provides the information to the operators at the central SCADA monitoring area.

4.3.5 Troubleshooting Procedures

Common causes of system failure and their remedies are shown in Table 4-8.

TABLE 4-8

Troubleshooting

Indicator	Probable Cause	Check/Monitor	Solution
Power system/No feed flow	Power off to well pump	Check power Check breaker Check well-level switch	Turn on power Reset breaker after correcting cause Reset well-level switch
No flow at a pump (applies to all pumps)	Power supply off	Check power Check breaker	Turn on power Reset breaker after correcting cause
High pipeline pressures	Partially closed valve Clogged carbon units or obstructions in pipeline	Check downstream valves Check pressure gauges throughout system	Open valves Isolate area of clogging or obstruction and resolve
Substantial pressure drop across carbon vessels	Partially closed valve Clogged carbon bed	Check downstream valves Check pressure gauges throughout system	Open valves Backwash carbon vessels and change out carbon

4.4 MAINTENANCE

This section describes routine treatment plant maintenance procedures and the frequency for monitoring operational parameters. Proper equipment maintenance is essential for the operation of an effective and efficient plant and for the safety of the operators. The treatment plant operating parameters are monitored so that plant performance during startup and normal operation can be evaluated and repair activities and maintenance can be scheduled to minimize costs, plant downtime, and major equipment failures. This will provide the plant operators with the information required to perform preventive equipment maintenance. The plant operator is responsible for maintaining a safe and functioning facility. Detailed information for equipment maintenance is provided in the manufacturers’ instruction manuals in Volume II of this OMP manual; the following subsections supplement the details provided there.

4.4.1 Site Maintenance

Site maintenance is necessary to keep the treatment plant functioning properly and to maintain facility appearance. Neglect of site conditions can cause deterioration of the roads and pads, resulting in safety hazards and, eventually, poor system performance.

General observation of facility grounds is usually sufficient to determine whether any major problems are present. Routine inspections are not required; however, the operator must maintain the treatment plant in a clean and well-kept condition consistent with public satisfaction.

4.4.2 Monitoring Frequency for Treatment Plant Operational Parameters

The treatment plant operational parameters and their monitoring frequencies are summarized in Table 4-9. The data log for recording system operational parameters is provided in each SBMWD treatment plant

TABLE 4-9

Monitoring Frequencies for System Operational Parameters

Task/Operational Parameter	Frequency - First Two Weeks	Frequency - Routine Operation
Record water flow rates to treatment plant	Daily	Daily
Record inlet and outlet pressures in GAC vessels	Daily	Weekly

GAC granular activated carbon

operations plan. It includes entries for recording inlet and outlet pressures, instantaneous and totalized flows to GAC vessels, water quality, and backwash cycles.

During initial system operation, data collection will be more frequent because operational irregularities are likely to be associated with startup. System operating data will be gathered at least hourly for the first four hours of operation. System data can then be gathered at least twice daily, not less than 8 hours apart, during the second day of operation. Data will be gathered once per day for the next two weeks and weekly thereafter, except when the system must be restarted after a significant downtime.

Apart from monitoring treatment plant operational parameters, routine preventive maintenance should be performed on the components. The schedule to perform routine preventive maintenance is presented in the SBMWD treatment plant operations plans.

4.4.3 Maintenance of Treatment Plant Components

Individual components should be maintained according to the manufacturers' instruction manuals presented in Volume II of this OMP manual. As outlined earlier, Table 4-9 and the routine preventive maintenance schedule should be used as a guide for treatment plant component maintenance. The following sections present procedures addressing the carbon units, the chlorination system, the effluent and backwash pipes, electronics calibration, and record keeping.

4.4.3.1 Carbon Units

The carbon vessels are self-operating. Carbon vessel maintenance includes: monitoring for breakthrough of the lead vessel; coordinating the replacement of spent carbon; routine recording of flow and pressure data to determine the requirements for backwashing; coordinating backwashing; periodically operating the valves; and checking for leaks and rust. The SBMWD sampling procedure to identify break through of the lead vessel for maximum carbon use and to determine carbon change-out is presented in Attachment 1. Procedures for carbon replacement and backwashing are presented hereafter.

Each pair of carbon vessels operates in series and has the ability to operate the lag vessel while the lead vessel is being serviced (see Table 4-6). Carbon can be replaced without a complete plant shutdown.

Procedures for coordinating carbon replacement operations are described generally in this OMP manual. The actual carbon replacement is performed by a carbon replacement and reactivation company. All procedures for carbon replacement will be in accordance with the manufacturer's instructions. The SBMWD treatment plant operations plan checklists for carbon changeout should be reviewed before performing this task.

In general, three steps should be followed to replace the spent carbon in the carbon vessel and place the vessel back online. The three steps, carbon evacuation, carbon filling, and carbon conditioning, are described hereafter.

Step 1: Carbon Evacuation

1. Contact a qualified carbon hauling and reactivation facility, per the *SBMWD Waterman Treatment Plant Operations Plan* checklist (SBMWD, 1998), to schedule carbon replacement for the 20,000-pound unit(s).
2. When carbon replacement operations are ready to begin, bypass the lead unit in accordance with Table 4-6.
3. Backwash the carbon vessel at 1,100 gpm for approximately 3 to 5 minutes. The purpose of this backwash is to loosen up the carbon to facilitate the evacuation of carbon from the vessel.
4. Attach a pneumatic hose to the 4-inch diameter carbon fill line, keeping the carbon fill valve closed. Connect a carbon slurry hose to the carbon discharge line and to the receiving carbon truck. Pressurize the vessel with 20 psi of air using an air compressor. Open the carbon discharge valve; the carbon slurry will evacuate the vessel and go into the truck.
5. When the carbon has exited the vessel, rinse the vessel to remove the remaining carbon, which may be sticking to the walls. To accomplish this, turn the backwash water to a low flow rate (100 gpm) and run it through the raw water influent line in the top of the vessel. This low flow rate will rinse out the remaining carbon. Visually inspect the effluent through a clear plastic fitting in the slurry hose to confirm that the water is clean and that the remaining carbon has been rinsed out of the vessel. Finally, close the bottom carbon slurry line valve.
6. Vent any residual pressure to the atmosphere, open the vessel's rear manhole, and visually inspect the interior of the vessel through the rear manhole. Do not physically enter the vessel. Inspect for signs of corrosion, rust, structural deficiencies, cracks, the integrity of the diffusers, and damage to and/or blistering of the epoxy coating. Note: GAC corrodes carbon steel. To protect the vessel, compromised epoxy coatings must be repaired before returning the vessel to service.
7. When the inspection of the vessel is completed, decontaminate the inside of the vessel with a 300 parts per million (ppm) solution of sodium hypochlorite. When decontamination is completed, refasten the manhole.
8. Use chain-of-custody procedures and forms to track carbon disposal. Ensure that a certificate of destruction is received from the disposal/recycling facility.

Step 2: Carbon Filling

1. Connect the carbon fill hose from the carbon truck to the 4-inch diameter carbon fill pipe on the side of the carbon vessel. Set the valves on the vessel to direct the discharge to the backwash discharge pipe. Apply 15 psi of pneumatic pressure and open the carbon fill valve on the fill pipe on the side of the vessel. The carbon slurry will then fill the tank. When the truck is empty, disconnect the fill hose and close the carbon fill pipe valve.

Step 3: Carbon Conditioning

Once the vessel is full of carbon, it must be conditioned. Conditioning involves saturating the carbon with water, making it ready for adsorption by contaminants.

1. Apply a 100-gpm backwash to the carbon bed for 24 hours.
2. When the backwash is completed, perform two bacteriological tests to establish that there is no bacteriological contamination in the vessel. The first is an 18-hour test called a Co-Alert test. The second is a standard 48-hour bacteriological test. If the 18-hour test results come back clean, proceed to the next step. If the vessel is not clean, wait for the results of the 48-hour test results. If the 48-hour test results are clean, proceed to the next step. If the vessel is not clean after the 48-hour test, call the carbon vendor.

3. When bacteriological tests return clean, perform a full backwash to rinse the fines and dust out of the carbon. This backwash will be performed at 1,200 to 1,500 gpm and will last approximately 30 to 45 minutes. During this step, it is important to turn on the backwash water slowly to prevent flushing the carbon out of the backwash discharge pipe. Backwash the vessel until grab samples from the discharge pipe are clear of fines and dust.

   Note: When backwashing, close the top air-release valve to prevent carbon from entering the valve and clogging it.

4. Turn off the backwash and put the vessel into normal series operation, with the newly changed out vessel in the lag position. Set the flow at a steady state and take the DHS-required pH samples at the 5 bed volumes, 100 bed volumes, and 200 bed volumes. Once the pH samples have been taken, open up all of the vessels in the plant and commence normal plant operation.

4.4.3.2 Chlorination System

Chlorine system maintenance includes checking the chlorine dose and chlorine residual and making sure the cylinders have enough chlorine supply. The following maintenance is performed on the chlorine system.

1. Check the chlorine dosage daily and adjust it to maintain a chlorine residual of 0.5 mg/L in the treated water.
2. Check the chlorine residual one time each shift.
3. Check the scales of the chlorine system to determine the quantity in the cylinders. Calculate the quantity of the chlorine used in pounds during each shift to make sure the use rate is in an acceptable range.
4. If chlorine in the tank falls below the acceptable range, follow the SBMWD procedure to replace the depleted cylinder with a new one.
5. Note any unusual sound coming from any equipment and perform repairs as needed.
6. Keep the chlorine system room clean for the safety of the operators.
7. Calibrate the chlorine dose meters annually.

4.4.3.3 Effluent Pipe Header and Backwash Discharge Pipe

The effluent pipe header is expected to require little maintenance. Periodically, the air accumulated from the flow through the effluent pipe requires release through the effluent pipe air-release valve at the top of the anti-siphon loop. Periodic inspection will include a check for any leakage in the pipe. The pipeline segment should be repaired immediately after leakage is detected.

The maintenance of the backwash discharge pipe is the same as the maintenance of the effluent pipe header, with the exception of the air-release procedure (there are no air-release valves on the backwash discharge pipe).

4.4.3.4 Calibration of Electronics

Correct calibration of the electronic sensors should be confirmed every two weeks for the first three months of operation. This frequency is necessary to establish baseline readings for the electronic drift of each sensor. Proper calibration of the flow meters is confirmed by comparing the mechanical reading with the SCADA digital reading. The differential pressure transducers are checked using the manual pressure gauges on the carbon vessels. At the end of the first three-month period, the calibration confirmation period may be extended if no drift is encountered. While sensors are expected to remain stable over long periods, the maximum confirmation interval must be no longer than three months. If, at any time, readings from the sensors become erroneous, the sensors must be examined for calibration to ensure that they are still functioning properly. Perform calibration as outlined in the manufacturer’s manual. Flow meters are calibrated annually.

4.4.3.5 Record Keeping

Records of the maintenance activities will be kept at the treatment plant by the SBMWD. The forms for record keeping are presented in the SBMWD treatment plant operations plans. These records will include daily, weekly, and monthly operational details (flow rates, total flow, pressures, contaminant loading to the vessels, water quality data, and chlorine record, etc.) and the preventive maintenance performed on the system components (instrumentation calibration, carbon change out, carbon backwashing and replacement, and component repairs). A log book is kept on site. It will contain the following information:

- Chlorine residual;
- Chlorine dosage;
- Chlorine feed rate;
- Equipment status;
- Flow rate; and
- Pressure.

All other records are kept at the Operations office at 195 North D Street.

4.5 REMEDY CONFORMANCE

Remedy conformance for the treatment plants will be accomplished if effluent from all sites does not meet or exceed detection limits for PCE and TCE or exceed maximum contaminant levels (MCLs) for all other constituents.

5.0 MONITORING WELLS

This section describes the OMP of the monitoring wells and their components. Figure 5-1 presents the significant mechanical details of the monitoring well systems.

5.1 DESCRIPTION

5.1.1 Locations

5.1.1.1 North Area Wells

Six monitoring wells are associated with the North Area Superfund Site (MW-07, MW-02, MW-04, MW-17, MW-09, and MW-16). See Table 5-1 and Figure 1-2 for locations.

5.1.1.2 South Area Wells

Eight monitoring wells are associated with the South Area Superfund Site (MW-130, MW-10, MW-11, MW-12, MW-13, MW-14, MW-15, and MW-01). See Table 5-1 and Figure 1-3 for locations.

5.1.2 Construction of the Monitoring Wells

Table 5-1 describes the locations, depths, screened intervals, and diameters of each monitoring well. Figure 5-1 provides a typical monitoring well schematic.

TABLE 5-1

Monitoring Well Locations, Depths, Screened Intervals, and Diameters

Monitoring Well Number	Location	Depth (feet)	Screened Intervals (feet)	Diameter (inches)
North Area				
MW-02	San Bernardino County drainage ditch, western side	A 300 B 390	A 280-300 B 370-390	3
MW-04	Newmark wellfield, western side	A 275 B 395	A 265-275 B 385-395	3
MW-07	48th and Kendall, southwestern corner	A 325 B 506	A 305-325 B 486-506	3
MW-09	4th Avenue and Kendall, southeastern corner	A 285 B 365	A 265-285 B 345-365	3
MW-16	4th Avenue western side, between 41st and 42nd	A 240 B 450	A 220-240 B 430-450	4
MW-17	48th Street, west of 4th Avenue	A 290 B 420	A 270-290 B 400-420	4

TABLE 5-1 (Continued)

Monitoring Well Number	Location	Depth (feet)	Screened Intervals (feet)	Diameter (inches)
South Area				
MW-01	In Mountain View median strip, between 23rd and 24th	982	A 232-242 B 294-304 C 380-390 D 486-496 E 560-570 F 642-652 G 704-714 H 820-830 I 897-907 J 950-960	5
MW-10	Magnolia and Arrowhead, southeastern corner	A 380 B 520 C 870	A 350-380 B 490-520 C 750-780	3
MW-11	Baseline and Genevieve, sidewalk of 98¢ Store	A 530 B 800 C 1,100	A 500-530 B 770-800 C 1,070-1,100	4
MW-12	10th Street, west of Acacia	A 270 B 700 C 1,070	A 240-270 B 670-700 C 1,040-1,070	4
MW-13	10th Street, east of Arrowhead	A 395 B 555 C 845	A 365-395 B 525-555 C 815-845	4
MW-14	10th Street, east of Sierra	A 300 B 600 C 1,090	A 270-300 B 570-600 C 1,060-1,090	4
MW-15	Waterman, across from 10th Street	A 550 B 720 C 1,050	A 520-550 B 690-720 C 1,020-1,050	4
MW-130	Mt. Vernon to 19th, left on Garner, end of street	A 370 B 580 C 920	A 340-370 B 550-580 C 890-920	4

MW monitoring well

5.1.3 Goals of the Monitoring Well System

The goals of the monitoring well system are to evaluate the performance of the groundwater extraction system, monitor the groundwater contaminant plume, and monitor the groundwater flow direction to ensure the proper placement of extraction wells and monitoring wells. Information obtained from monitoring wells also is used to determine the extraction rates to more effectively control the groundwater contaminant plume.

5.1.3.1 North Area Wells

The monitoring wells in the North Area are near a suspected source of contamination. Therefore, the levels of contaminants in this area are relatively higher than in other areas of the Newmark OU. The monitoring wells in the source area are being sampled to ensure that contaminant concentrations in these wells are decreasing, which will indicate that the contaminant mass is being removed by groundwater extraction and/or by natural attenuation.

5.1.3.2 South Area Wells

The monitoring wells in the South Area are situated to determine groundwater contamination upgradient and downgradient from the groundwater extraction wells, to ensure that the plume is not spreading. None of the contaminants of concern related to the Newmark OU should be detected in the monitoring wells at the leading edge of the plume, downgradient from the extraction wells.

5.2 COMPONENTS

The monitoring well components are shown in Figure 5-1. The passive diffusion bag sampling units, water-level transducers, data loggers, pumps, and casings and well screens are described hereafter.

5.2.1 Passive Diffusion Bag Sampling Unit

Groundwater sampling is conducted at all but one monitoring well (MW-01) using a passive diffusion bag sampler. The passive diffusion bag sampler is a plastic bag filled with uncontaminated water that is lowered into a monitoring well and retrieved later. While the diffusion bag is in the monitoring well, contaminants from the well migrate into it by diffusion. When the well is sampled, the sampling unit is raised to the surface using a reel, the bag is pierced, and its contents are emptied into appropriate water sampling containers, which are then shipped off site for analysis.

The passive diffusion bag sampling unit is made up of several components. Listed in order, from the top of the well to the bottom, the components are:

- A hook that connects to the well cap to hold the sampler in place in the well;
- A length of stainless steel wire rope that holds the diffusion bag sampler at the proper screen depth in the well;
- A wiffle ball that keeps the passive diffusion bag sampler near the middle of the well and away from the well walls to ensure a pure sample;
- The passive diffusion bag sampler;
- Another wiffle ball;
- Another length of stainless steel wire rope corresponding to the proper screen height above the bottom of the well; and
- A stainless steel weight that rests on the bottom of the well.

5.2.2 Water-Level Transducers

Water-level transducers, which are attached to a data logger, measure static water pressure that can be correlated directly with water-level elevations. Water levels are used to determine groundwater flow direction. The transducers are situated in the wells at all times to allow for periodic readings.

5.2.3 Data Loggers

The data logger receives pressure data from the water-level transducer(s). It also records and stores data until the data are downloaded from the unit. The data logger is programmed to take one reading per day. It is located in the well box next to the wellheads.

5.2.4 Pumps

Well MW-01 contains a Waterloo multi-level sampling system that can pump water from any well depth. Since there have been no detections in this monitoring well, and because the multi-level sampling system is not functioning properly, this well has not been sampled recently and will soon be removed from the sampling program and abandoned. The method of abandonment is yet to be determined.

5.2.5 Casings and Well Screens

The well casings for all wells are carbon steel. Well screens are constructed of slotted stainless steel.

5.3 OPERATION

The monitoring wells are sampled semi-annually for VOCs. All wells except MW-01 are using passive diffusion bag sampling units. (MW-01 is not currently being sampled and is to be abandoned.) Samples are retrieved from the passive diffusion bag samplers using proper sample containers and chain-of-custody procedures and are then sent to a laboratory for analyses.

5.4 MAINTENANCE

The monitoring wells require very little maintenance. Operation and maintenance considerations consist primarily of keeping the well caps secure to prevent surface contamination from impacting the wells and keeping the wells accessible for sampling. If the well screens clog, the wells may have to be cleaned and redeveloped.

5.4.1 Site Maintenance

The areas around the monitoring wells will be inspected periodically to ensure they are kept clear of refuse, weeds, and any other materials that may hamper biannual sampling.

5.4.2 Monitoring Frequency for Operating Parameters

Water-level measurements will be taken daily in each monitoring well and will be used to calculate groundwater elevations and groundwater flow direction.

Groundwater samples will be collected and analyzed for VOCs twice each year.

5.4.3 Monitoring Well Component Maintenance

The water-level transducer and data logger will be maintained in accordance with the manufacturers' recommendations.

5.5 REMEDY CONFORMANCE

5.5.1 North Area Wells

Decreasing levels of PCE and TCE over time in North Area monitoring wells indicate that the mass of contamination at the Newmark OU source area is being reduced by groundwater extraction and treatment and/or natural attenuation. This signifies the adequate performance of the remedy in this area.

5.5.2 South Area Wells

No statistically significant increases in levels of PCE and TCE over time in monitoring wells MW-12, MW-13, MW-14, and MW-15 indicate that the extraction system is impeding the migration of the contaminant plume. This signifies the adequate performance of the remedy in this area.

6.0 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

(Provided by San Bernardino Municipal Water Department.)

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ATTACHMENT 1

SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
SAMPLING PROCEDURE FOR
CARBON CHANGE-OUT
OCTOBER 11, 2000

San Bernardino Municipal Water Department
Sampling Procedure for Carbon Change-Out
October 11, 2000

During the initial start-up of EPA GAC Treatment Plants, State Health required additional sampling. During that period it was cost effective to change the carbon when it reached a level of 3.75 µg/L which is 75% of the MCL of 5 µg/L. This sampling routine was later reviewed and reduced. The following factors are used to establish the new sampling procedure and carbon change-out.

1. State Health Permit for the City of San Bernardino Municipal Water System (Water Permit No. 03-13-99P-002 dated December 1999) states "The effluent from all GAC and PTA treatment sites shall not exceed applicable MCLs or Action Levels for all constituents or concern, **except TCE and PCE, which shall be non-detect.** The list of constituents of concern shall be updated and promptly reported to the Department whenever concentrations of known contaminants increase or new constituents are found in the aquifer contaminants. The list of constituents of concern shall be included in all GAC and PTA operations plans.

2. PCE/TCE will be Sampled Monthly on all Lead Vessel Effluent until it reaches 50% of the MCL (2.5 µg/L) at which time bi-monthly sampling will be required. When levels reach 75% of the MCL (3.75 µg/L) weekly sampling is required. (Note: State Health Policy memo 97-007 Granular Activated Carbon (GAC), Monitoring Procedures for GAC Filters states that "have the lab reports from the previous week's results to you before you collect the subsequent weekly sample".

3. When the chemical level reaches the MCL or above (5 µg/L), take the vessel(s) off line and change out the carbon.

4. The current cost per sample (PCE/TCE) is $50.00. They usually are not completed and sent with-in a one week or sometime with-in the two week period established in item # 2 above. To have these sample results guaranteed to us prior to the next sample currently cost 50% more or $75 per PCE/TCE Lead Vessel sample. Initially it wasn't cost effective with the increased monitoring due to the low levels of PCE/TCE, now however with 50% fewer required samples the additional cost becomes cost effective. (i.e. 75% of the vessel carbon being exhausted leaving 25% left to load (25% of 20,000 pounds equals 5,000 pounds of carbon @ $0.53 per pound is equal to $2,650 worth of carbon.) This allows for approx. 35 samples or an additional 8 months of loading before it become cost prohibitive. Depending on the site and influent levels we should be able to load the vessels to the MCL or equal to the influent concentration that is considered breakthrough.

   As seen in the attached Carbon Life loading sheets, the vessels do not load equally. When the levels reach 2.5 µg/L in the effluent of the lead vessel the operators will attempt to throttle back that vessel and increase flows to the vessels with lower levels. They are limited by the design flow of 750 G PM, we will assess the cost benefit of doing this in a few months and adjust our procedures at that time if necessary.

SUMMARY

Carbon will be changed out when PCE/TCE levels is confirmed at greater than 5 µg/L in the combined effluent. (per item 1 above)

Carbon will be changed out when it reaches the MCL (5 µg/L) of the lead vessel. (per item 3 above.)

Carbon will be changed out when the effluent level is confirmed at or above the influent level concentration which is the highest constituent level, but equal to or under the MCL of 5 µg/L. (per item 4 above.)

Operators will attempt to maximize loading, by shifting flow from vessels above 2.5 µg/L to vessels lower than 2.5 µg/L. They will maintain records of additional time required and a cost benefit analysis will be done to evaluate the cost effectiveness. A decision will made at that time whether we continue with this process.

Michael Lowe
Operations Superintendent

APPENDIX A

GAC TREATMENT PLANT PARTS LIST

TABLE A-1
Waterman and North Plant Carbon Vessel Components

Item Number	Part Name	Size	Manufacturer	Model Number	Description*
1	Pressure Gauge	0.25" X 2.5"	Palmer Instruments	25CBD (0-100)	2.5" dial, Pressure Gauge, 0-100 psi
2	Ball Valve	0.5", 0.75", 1", 2"	Apollo	NA	Brass, Chome Ball Valve
3	Cam And Grooves	2",4"	Dixon Valve and Coupling Co.	200F-AL, 200DC-AL, 400-AL, 400-DC-AL	Cam-Lock and Groove Adapters, Aluminum
4	Industrial Spray Products	2"	Spraying Systems Co.	2HHSJ-PVC-1701400	Water Sprayer in Carbon Vessels
5	Ball Valve	4"	Fluid Controls	NA	316 SS Full Port Ball Valve
6	Combination Air Valves	1"	APCO	143-C	Pressure Air/Vac Vent
7	Rupture Disks	4"	ZOOK	NA	ZOOK Mono Graphite 75# Burst Disk
8	Series BG Resilient Seat Butterfly Valve	8"	Watts Regulator	GA4-M4	Series BG Resilient Seat Butterfly Valve
9	Flanged Tube Water Meter	8"	Water Specialties	ML-04-D	Water Meter
10	Water Meter Indicator, Totalizer, and Transmitter	To fit 8" meter	Water Specialties	TR-28	Water Meter Hardware
11	Meter Power Supply	for 8" meter	Water Specialties	IN-36-I	Water Meter Hardware
12	VIOK Chlorinator	NA	Wallace and Tiernan	BK # INI25.100A Iss. A	Water Chlorinator
13	Differential Pressure Indicating Transmitter	NA	Druck	STX 2100	Differential Pressure Indicating Transmitter

* Cut sheet located in Clearwater Environmental, Inc., Operations and Maintenance Instructions: Book 2, Section 5, Appendix B-Mechanical manuals

TABLE A-2
Waterman and North Plant Electrical Components

Item Number	Part Name	Manufacturer	Model Number	Description
1	Getting Started with DTAM PLUS	Allen-Bradley	NA	Users Manual
2	DTAM PLUS Operator Interface Module	Allen-Bradley	NA	PLC Hardware
3	SLC 500 Analog 1/0 Modules	Allen-Bradley	Catalogue No. 174-NI4, -NI041, -NI04V, -N041, and -N04V	PLC Hardware
4	SLC 500 Programmable Controller RS-232 to RS-485 Interface Controller Catalog # 1747-PLC	Allen-Bradley	Catalogue No. 1747-PLC	PLC Hardware
5	SLC 5/01 and SLC 5/02 Modular Processor	Allen-Bradley	NA	PLC Hardware
6	SLC 500 Power Supplies	Allen-Bradley	NA	PLC Hardware
7	Discrete Module I/0	Allen-Bradley	NA	PLC Hardware
8	SLC 500 Module Chassis	Allen-Bradley	NA	PLC Hardware
9	Operations and Maintenance Controls	Excel Automation and Electric	NA	PLC Software
10	Solid State Annunciator Systems	Ronan	Series X12 and X16	PLC Hardware
11	Digital Indicator-Totalizer Transmitter	Water Specialties	Tr-28-1/Tr 28-1-T	Water Meter Hardware
12	3"-20" Electronic Mainline Meter	Water Specialties	NA	Water Meter Body
13	Electric Actuator/Positioner	Wallace & Tiernan	BK# IM40.300AA UA lss. A	Electric Actuator / Positioner
14	Signal Conditioning Unit	Wallace & Tiernan	BK# IM40.100AA UA lss. A	Signal Conditioning Unit
15	Ultra Slimpak DC Input Field Configurable Isolator	Action Instruments	G408-001/ 1001	PLC Hardware

***Cut sheet located in Clearwater Environmental, Inc., Operations and maintenance Instructions: Book 2, Section 5, Appendix A-Electrical Manual**

TABLE A-3
Waterman and North Plant Yard Piping Components

Item Number	Part Name	Size	Manufacturer	Model Number	Description
1	Ductile Iron Pipe	20"	Pacific States Cast Iron Pipe Company	NA	20" Cement Lined, Class 50 Plan MJ/TJ x Plain End Ductile Iron Pipe
2	Ductile Iron Pipe	24"	Pacific States Cast Iron Pipe Company	NA	24" Cement Lined, Class 50 Plan MJ/TJ x Plain End Ductile Iron Pipe
3	Flow Meters	8"	Water Specialties	ML-04	8" Propeller Flow Meter
4	Flow Meters	24"	Water Specialties	ML-04	24" Propeller Flow Meter
5	Flanged Fittings	20" and 24"	Tyler/Union	NA	Ductile Iron C110 Flanged Fittings, 90°, 45°, 22.5°, 11.25° Elbows
6	Flanged Fittings	20" and 24"	Tyler/Union	NA	Ductile Iron C110 Flanged Fittings Tees, Reducing Tees, Crosses, and Reducers
7	Restrained Joints	20" and 24"	EBAA IRON SALES, Inc.	NA	Megalug Restrained Joints (Mechanical Joint)
8	Butterfly Valves	24"	Pratt	NA	Groundhog and Triton HP-250 Butterfly Valves 24" for Buried Use
9	Plug Valve		Pratt	NA	Eccentric Plug Valve
11	Check Valve		American Flow Control	NA	Swing Check Valves
12	Service Saddle		Ford	NA	Service Saddles
13	Service Saddle		Ford	NA	Service Saddles and Tapping Sleeves
14	Corporation Stop		Ford	NA	Corporation Stops and Ballcorps
15	Air Release Valve		APCO	NA	Combination Air Valve Series 140C
16	Plug Valve		Keystone Valve USA, Inc.	NA	Plug Valve, Ballcentric Plug Valve
17	Ductile Iron Flanges	8" and 20"	Pipe Works	NA	125# Ductile Iron Flange
18	Grey Iron Flanges		Pipe Works	NA	125# Grey Iron Flange

* Cut sheet located in Clearwater Environmental, Inc., Operations and Maintenance Instructions: Book 2, Section 5, Appendix B-Mechanical Manuals

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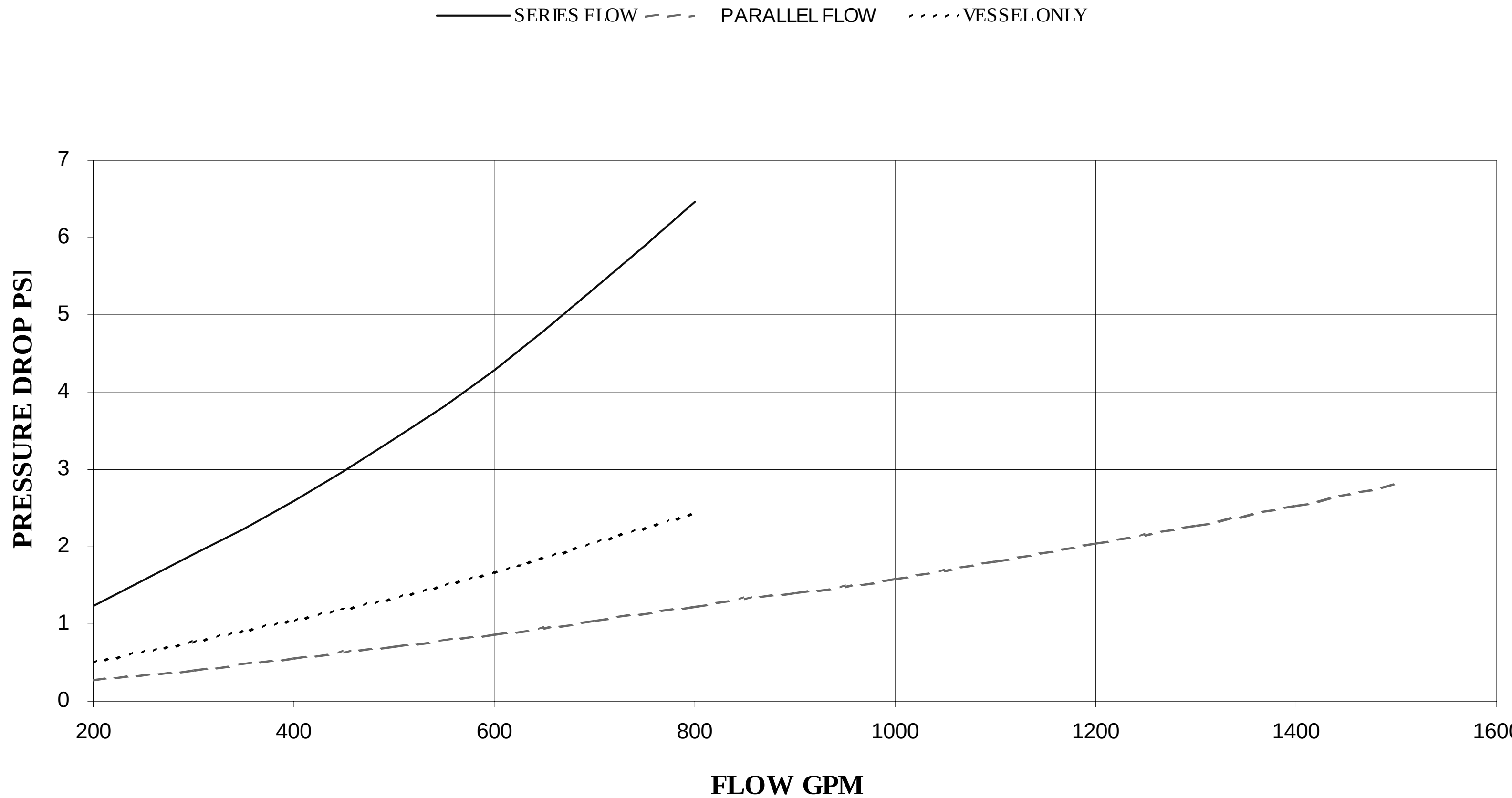
APPENDIX B

HP-1020S-SYS PRESSURE DROP

HP-1020S-SYS PRESSURE DROP

SERIES MODE WITH 8X30 CARBON 60°F
(2 VESSELS AND 8 INCH MANIFOLD)



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APPENDIX C

PM SCHEDULES AND TROUBLESHOOTING

TABLE C-1

Minimal First-Year PM Schedule

Maintenance Test	Testing Regime	Time Interval
Physical Inspection	Borehole color video	On new wells, then at pump service intervals
	Surface facility inspection - inspect and clean as needed at sampling points	Monthly or whenever visited
	Examination of pulled components	As needed, when pulled
Hydraulic Performance	Well discharge or acceptance (volume rate and pressure)	Weekly (recommend installation of automated data collection in accordance with CEGS 13405)*
	Drawdown or head change	Weekly (recommend installation of automated data collection)
	Graphical analysis	Quarterly
	Specific capacity test (well hydraulic performance) on selected representative wells	Annually on selected wells or at recommended shorter intervals
	Pump performance. Conduct step “pump” test of centrifugal pumps and similar wear analysis of positive displacement pumps and compare to “nominal” data.	At least annually, or at recommended shorter intervals if pump service is severe (Q/s and pump test can be single operation). Alternative: In maintenance system, include triggers for out-of-nominal power readings.
Electrical (Power)	System and motor volts, amperes, frequency, watts	When visited for service (recommend installation of current monitors with alarms)
Physical-Chemical	pH, mV, and temperature	At well start up and quarterly, using project onsite instruments (calibrated)
	Suspended particulate matter (sand, silt, clay)	At well testing, then at pump test intervals
Biofouling Microbial Component	BART analyses. After clog-typing, pick suitable test type (IRB, SRB, or SLYM) and monitor for change.	At well start up for baseline, then quarterly on selected representative wells
Treatments and Service	Well hydraulic improvement and pumping systems	As testing indicates Q/s or injection rate drops below 90% or pumping system degrades
	Instrumentation calibration	In accordance with CEGS 13405*

*CEGS 13405 specifies continuous metering, monitoring, and recording equipment for parameters such as flow, temperature, pressure, and physical-chemical properties of discharged fluids. It does not include methods for cleaning or other O&M issues.

BART	Biological Activity Reaction Test
DN	denitrifying bacteria
IRB	iron-related bacteria
O&M	operations and maintenance
SLYM	slime-forming bacteria
SRB	sulfate-reducing bacteria

TABLE C-2

Long-Term PM Schedule

Maintenance Test	Testing Regime	Time Interval
Physical Inspection	Borehole color video	At each major rehabilitation (before and after) or five years, whichever is sooner. Concentrate on screen and other stress points.
	Surface facility inspection - inspect and clean as needed at sampling points	Quarterly or each visit
	Examination of pulled components	As needed (at least test pump if not pulling it annually). Wells should be equipped for easy pulling, if at all possible.
Hydraulic Performance	Well discharge or acceptance (flow rate and pressure)	Weekly (recommend installation of automated data collection in accordance with CEGS 13405)*
	Drawdown	Weekly to biweekly (recommend installation of automated data collection)
	Graphical analysis	Quarterly
	Specific capacity test (well hydraulic performance)	Annually or at recommended shorter intervals for specific representative wells
	Pump performance. Conduct step "pump" test of centrifugal pumps and similar wear analysis of positive displacement pumps and compare to "nominal" data.	At least annually, or at recommended shorter intervals if pump service is severe (Q/s and pump test can be a single operation). Criterion for severe service: Pump replacement in 3 years or less.
Electrical (Power)	System and motor volts, amperes, frequency, watts	Weekly (recommend installation of current monitors with alarms)
Physical - Chemical	Inorganic parameters	At least quarterly using project onsite instruments (calibrated) or routine monitoring (laboratory)*
	Suspended particulate matter (sand, silt, clay)	Manually at well testing, then quarterly
	Turbidity	In line monitors (continuous)*
Biofouling Microbial Component	BART analyses. Pick one indicator type based on past performance (IRB, SRB, SLYM, DN) and use for a marker.	Quarterly. Watch others (IRB, SRB, SLYM) at least annually. May be discontinued if results vary little over time.
	Biofilm flow cell for microscopy	Annually on selected wells

TABLE C-2 (Continued)

Long-Term PM Schedule

Maintenance Test	Testing Regime	Time Interval
Treatments and Service	Well hydraulic improvement and pumping systems	As testing indicates Q/s drops below 90% or pumping system degrades
	Instrumentation calibration	In accordance with CEGS 13405*

*CEGS 13405 specifies continuous metering, monitoring, and recording of parameters such as flow, temperature, pressure, and physical-chemical properties of discharged fluids.
Reference: U.S. Army Corps of Engineers, 2000.

BART	Biological Activity Reaction Test
DN	denitrifying bacteria
IRB	iron-related bacteria
SRB	sulfate-reducing bacteria
SLYM	slime-forming bacteria

TABLE C-3

Troubleshooting New Site Data Needs

Parameter	**Potential Problems**
Fe and Mn (total, Fe^{2+}/Fe^{3+}, Fe minerals, Mn^{4+}/Mn^{2+}, Mn minerals and complexes) and sometimes other metals, such as Al. Select based on presumed geochemistry.	Indications of clogging potential, presence of biofouling, Eh shifts. Fe transformations are the most common among redox-sensitive metals in the environment. Mn is less common but locally important.
S (total S^{2-}/SO_4^{2-}, S minerals and complexes) as suspected given site geochemistry	Indications of corrosion and clogging potential, presence of biofouling, Eh shifts.
pH	Indication of acidity/basicity and likelihood of corrosion and/or mineral encrustation. Combined with Eh to determine likely metallic mineral states present.
Conductivity	Indication of TDS content and a component of corrosivity assessment.
Major ions	Carbonate materials, Fe, Ca, Mg, Na, and Cl determine the types of encrusting minerals that may be present and are used in saturation indices. One surrogate for many cations is total hardness.
Sand/silt content (v/v, w/v)	Indication of success of development and redevelopment, potential for abrasion and clogging.
Biofouling parameters	Select appropriate methods to permit a complete but convenient assessment of biofouling mechanisms present.

Al	aluminum
Ca	calcium
Cl	chlorine
Eh	redox potential
Fe	iron
Mg	magnesium
Mn	manganese
Na	sodium
S	sulfur
TDS	total dissolved solids
v/v	volume over volume
w/v	weight over volume